STANDARD OPERATING PROCEDURE NO. 5

SAMPLING OUTCROPS, ROCK PILES, AND DRILL CORE (SOLID)

REVISION LOG		
Revision Number	Description	Date
5.0	Original SOP (comments from Gomez, Jackson, Lueth)	1/16/04
5.1	Comments from G. Robinson, Hauff	1/20/04
5.2	Comments and changes to sampling existing drill cuttings from Brimhall	2/4/04
5.3	Revisions by PJP	5/20/2004
5.4	Revisions by PJP	6/1/2004
5.5	Revisions by PJP	9/15/2004
5v6	Revision by FFJ –UBC, approved by VTM, LMK edits	1/17/05 1/27/05
5v7	Changes accepted LMK, (Ginger review and approve please) so I can send to Jack H. & post to Granite server	2/7/05
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5v8	Finalized by LMK for posting to Utah website and to send to George Robinson for lab audit	3/20/07
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1.0 PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) provides technical guidance and methods that will be used to sample solid materials during environmental investigations at the Molycorp, Inc. (hereafter referred to as Molycorp) mine. This SOP is a supplement to the site-wide and investigation area specific workplans and field sampling plans (FSPs), and should be used in conjunction with the other SOPs in this volume.

2.0 RESPONSIBILITIES AND QUALIFICATIONS

The Project Manager and Characterization Team will have the overall responsibility for implementing this SOP. They will be responsible for assigning appropriate staff to implement this SOP and for ensuring that the procedures are followed accurately.

All personnel performing these procedures are required to have the appropriate health and safety training. In addition, all personnel are required to have a complete understanding of the procedures described within this SOP, and receive specific training regarding these procedures, if necessary.

All environmental staff and assay laboratory staff are responsible for reporting deviations from this SOP to the Team Leader.

3.0 DATA QUALITY OBJECTIVES

The characterization portion of this research project has identified nine DQOs (Data Quality Objectives), described in the QAPP (Quality Assurance Procedure Plan), that must be addressed in order to solve this problem. The field sampling plan specifically addresses eight of these DQOs, which are listed below:

- Determine how the hydrogeochemistry and water balance dynamics influence rock pile weathering and stability.
- Determine how the mineralogy, stratigraphy, and internal structure of the rock piles contribute to weathering and stability.
- Determine if the sequence of host rock hypogene and supergene alteration and weathering of the host rock within the alteration scars and outcrops can provide a basis to predict the effects weathering can have on mine rock stability.
- Determine if cementation forms in the rock piles and alteration scars and if so, determine how the cementation contributes to the stability of the rock piles.
- Determine how reactive the pyrite and carbonate minerals are so that a representative sample is used in the weathering cells.
- Determine how much pyrite is in the waste rock piles and where it is, and how the pyrite concentration affects the weathering process.
- Determine if pyrite oxidation, moisture content, and microbe populations affect rock pile weathering and stability.
- Determine if the geotechnical and geochemical characteristics of the bedrock and alteration scars (foundation) underlying the rock piles influence the rock pile stability.

4.0 RELATED STANDARD OPERATING PROCEDURES

The procedures set forth in this SOP are intended for use with the following SOPs:

- SOP 1 Data management (including verification and validation)
- SOP 2 Sample management (including chain of custody)
- SOP 3 Surveying (GPS) and coordinate systems
- SOP 4 Taking photographs
- SOP 6 Drilling, logging, and sampling of subsurface materials (solid)
- SOP 7 Decontamination of sampling equipment
- SOP 8 Sample preparation (solids)
- SOP 9 Test pit excavation, logging, and sampling (solid)
- SOP 36 Sample preservation, storage, and shipment
- Any other SOPs dealing with solid sample collection

5.0 TYPES OF SAMPLES TO BE COLLECTED

The following are the types of samples to be collected in this project and for which sampling procedures are described in this SOP.

- Rock outcrops
- Alteration scars
- Existing drill cuttings
- Existing drill core
- Disturbed soil sampling (unconsolidated to consolidated) collected with a spade or shovel
- Undisturbed soil samples (blocks)
- Subsurface soil samples collected with hand augers
- Test pit, trenches, and high wall select and composite samples
- Rock pile channel or transect sampling
- Select samples for specific analyses

Plastic bags with twist ties or ziploc plastic bags are preferred for sample containers to prevent contamination in most cases. Many cloth bags contain additives to enhance their strength, therefore, cloth bags that could contaminate the sample shall not be used for sample containers.. In cases where plastic bags are not appropriate, other containers will be used as specified in the SOP and on the field sample forms (for example, moisture content jars, paper or cloth for moist samples).

5.1 ROCK OUTCROPS

Purpose

Sample rock outcrops to compare them with weathered rock pile material.

Equipment list

- Rock hammer
- Chisel
- Hand lens
- Indelible black-ink pens
- Digital camera
- Health and Safety equipment as outlined in the Site-Specific Health and Safety Plan
- Appropriate sample containers and weatherproof sample labels
- Bound weatherproof field logbook
- Sample field data sheets
- Decontamination equipment (SOP 7)
- Heavyweight latex gloves

Sampling procedures

1. The sampling will focus on selected outcrops which represent specific rock types and alteration assemblages.
2. Using hammer, clean the rock surface to avoid superficial alteration materials.
3. Collect 3-5 kg of rock using hammer and chisel.
4. Take GPS survey reading (SOP 3 and record it along with coordinate system used).
5. Take a digital photograph of the outcrop (SOP 4) using a bar scale. Record the photo number with the sample number and the GPS location on the sample form and in your field logbook..
6. Fill out field sample form and chain of custody form (SOP 2).

Sample collection

Each collected rock sample will include a thin section sample (SOP 8), 500g for chemical analyses, and an archive sample (at least 200 grams of representative material)..

5.2 ALTERATION SCARS

Purpose

- Determine lithologies that lead to alteration scar development
- Determine effects of acid weathering on host lithologies
- Determine extent of hypogene and supergene alteration
- Determine a weathering index (or indices) for the alterations scars
- Evaluate if weathering index for alteration scars is applicable to rock piles

Equipment list

- Bound weatherproof field logbook
- Indelible ink pens
- Rock hammers and chisels
- Appropriate sample bags with weatherproof labels
- Digital camera
- Sample forms
- Hand lens for field identifications
- Health and Safety equipment as outlined in the Site-Specific Health and Safety Plan

Sampling procedures

Prior to sampling all safety precautions for using hammers and chisels will be reviewed. In addition, care should be taken at sample locations to minimize the risk of rock falls while sampling. Samples should be taken from areas with good footing to prevent personnel falls. Water in areas of the alteration scars is very acidic and extra care should be exercised near natural seeps.

Sampling procedures are as follows:

- Safety glasses must be worn whenever striking or prying rock samples.
- Use only clean, unused bags for sample storage
- Number all samples with indelible ink, inside and outside of the sample bag.
- Make sure all bags are completely sealed prior to storage, double bag if necessary.

- Each collected rock sample will include enough material for a thin section sample (SOP 8), 500g for chemical analyses, and an archive sample (at least 200 grams of representative material).

Sample collection

1. Determine lithologies within alteration scars by field identification. Examination of debris flow materials can quickly help to determine the variation in host rock lithologies present in the scar.
2. Sample unique lithologies based on variations of primary mineralogy and/or secondary mineralogy while paying close attention to degrees of hypogene and/or supergene alteration.
3. Break sample from outcrop with hammer or pry from fractured rocks with chisel.
4. Number sample and store in resealable bag – use the size most appropriate for the required sample volume.
5. Take and record a GPS survey reading (SOP 3), using the appropriate coordinate system and record it with the reading.
6. Take a digital photograph of the outcrop (SOP 4) with a scale bar.
7. Fill out field sample form and chain of custody form (SOP 2).
8. Label and handle the sample containers in accordance with SOP 2, Sample Management

5.3 EXISTING DRILL CUTTINGS

Purpose

To collect representative dual tube percussion hammer drill-cutting samples for pyrite reserve and acid base accounting analyses.

Equipment list

- Sample splitter
- Health and Safety equipment as outlined in the Site-Specific Health and Safety Plan
- Metal and magnetic point pens
- Appropriate sample containers (buckets and ziploc bags) and weatherproof labels
- Bound weatherproof field logbook and indelible pens
- Decontamination equipment (SOP 7)
- Hammer
- Hand lens
- Pocket knife
- Adhesive tape
- Bucket opener
- Permanent markers
- Chip trays
- Stainless steel and plastic trowels
- Paper towels

Sampling procedures

1. Locate the appropriate 5-gallon buckets of stored drill cuttings.
2. Open the sealed 5-gallon buckets you need to sample by using a pocketknife to cut the lid at the tabs that keep the lid sealed and use the bucket opener to remove the lid. Keep the lid available.
3. Divide the sample into three approximately equal parts by pouring it into three clean buckets.
4. Mix the sample in each bucket thoroughly with trowels to make it as homogenous as possible.
5. Put the empty original sample bucket at the discharge end of the sample splitter and a clean plastic pan at the receiving end.
6. Pour half of the sample into a second clean bucket and mix the cuttings in each bucket with a clean trowel or shovel.
7. Pour the mixed cuttings back into one bucket. To mix more thoroughly, pour the entire bucket contents into a second clean bucket and then pour the second bucket contents back into the original bucket.
8. Split the sample with a splitter until 1,000 grams of material is separated out.
9. Pour each of the three buckets of samples into the sample splitter to split the total amount of the sample into two: one portion goes into the original bucket and the other into the plastic pan.
10. Re-split the sample in the plastic pan to obtain approximately 1,000 grams of sample.
11. Take a spoon or trowel to sample 200 additional grams of material for the archive sample.
12. Place the 1,000 gram sample into a plastic sample bag and label it in accordance with SOP 2.0. The remaining material is stored in the original buckets at the mine.
13. Fill out the field sample form and chain of custody form (SOP 2) in the database on the computer.
14. Record the hole id, the hole depth interval, and the sample name in a bound field note book.
15. After collecting each sample, decontaminate the mixing and splitting equipment with brushes and/or an air compressor.
16. For QA/QC (Quality Assurance/Quality Control) purposes, a blind triplicate sample will be collected for every 25 samples.
17. Samples will be secured and sealed in clean, labeled, sealed, 5-gallon buckets for shipment by Bureau vehicles to New Mexico Tech for storage and then processing.
18. Shipping buckets will be labeled with the date of collection and the first and last of the sequential sample numbers contained within.

SPECIAL CASES

Wet samples

If the sample is wet such that it cannot be split with the splitter, homogenize the sample in the three buckets and take representative portions from each of the buckets to make approximately 1,000 grams for bagging. Use water and paper towels to decontaminate the equipment after each wet sample.

Small samples
If the sample is very small (i.e. less than 1,000 grams or just a few pieces of rock), homogenize the material in the original bucket and take a representative sample, leaving some portion of the material in the original storage bucket for reference.

EXISTING DRILL CORES

Purpose

- Log, visually describe, and sample pertinent cores from the original overburden of the open pit deposit. These cores were drilled prior to mining and placing material in the rock piles.
- Samples of different rock types, different alteration assemblages, and degrees of alteration will be collected and analyzed and then compared to rock pile analyses and drill core records to find out which areas of the overburden were dumped into each rock pile.
- Find correlations between dumping times and locations in the rock piles.

Equipment list

- Rock pick
- Diamond saw
- Digital camera
- Health and Safety equipment as outlined in the Site-Specific Health and Safety Plan
- HCl bottle for carbonate testing
- Metal and magnetic point pens
- Magnifier or hand lens
- Appropriate sample containers and weatherproof labels
- Bound weatherproof field logbook and indelible pens
- Field sample form
- Stainless steel spoon

Sampling procedures

1. Examine selected existing drill logs and cores. Re-log the core if appropriate (SOP 6), adding any new information that may be relevant (lithology description, classification, etc.).
2. Scan with reflectance spectroscopy (SOP 41), if available, to identify sulfates, carbonates, and hydrate minerals. Record observable mineralogy and petrology. Determine and record relative proportions of ore minerals.
3. Collect samples of each major lithology and alteration assemblage. Select samples of well-cemented material specifically to examine the cementation.
4. Take GPS survey reading (SOP 3), record reading and coordinate system used..
5. Take a digital photograph of the outcrop (SOP 4) with a scale bar.
6. Fill out field sample form and chain of custody (SOP 2).
7. Use diamond saw to cut a 7x4x3 cm slab for thin section preparation and archive remaining hand specimen (SOP 8).

8. Collect a 1-3 kg sample or 30-50 cm long section of the core for chemical analysis, bag and label sample.

5.5 DISTURBED SOIL SAMPLING WITH A SPADE OR SHOVEL

Purpose
Sampling disturbed soils.

Equipment list for disturbed samples
- Steel spoon or hand auger or trowel
- Stainless steel pick
- Surveying stakes, lath, paint, or flags
- Stainless steel bowl
- Appropriate sample containers and weatherproof labels
- Measuring tape
- Health and Safety equipment as outlined in the Site-Specific Health and Safety Plan
- Bound weatherproof field logbook and indelible ink pens
- Sample field data sheets
- Decontamination equipment (SOP 7)
- GPS unit (SOP 3) with appropriate coordinates set.

Sampling procedures

Surface material samples can be collected as grab or composite samples, as specified in FSP (Field Sampling Plan). Selected samples of well-cemented material can be sampled specifically to examine the cementation. Samples should be collected from the depth range of 0 to 6 inches. Prior to sampling, it is important to calculate the total volume of sample material to be collected at each incremental sample location. Ensure that the volume required for each analysis is collected and completely fills each sample container. The analysis-specific volumes are specified in the QAPP. Sampling locations specified in the FSP will be identified and marked using surveying stakes, lath, paint, or flags. Using a chemically inert, steel spade or shovel, collect fine soil samples from representative areas of the rock piles. A total of 1 gallon (4 liters) of soil should be collected from each site. Sampling equipment should be acid-washed and thoroughly rinsed with deionized water prior to use in the field and decontaminated between samples (SOP 7).

For grab samples, one surface material sample will be collected at each proposed sample location. Grab sample material will be homogenized (mixed) in a stainless steel bowl before filling sample containers.

For composite samples, unless specified differently in the applicable FSP, composite surface material samples will be comprised of 5 incremental sub-samples collected from each of the corners and center point of a 1-meter square. All or a portion of the incremental samples are mixed together to create a composite sample representative of the average constituent concentrations within the area to be characterized. For a given composite sample, the volume of each incremental sample must be the same, and must equal 1/n of the required

composite sample volume, where n equals the number of incremental samples making up the composite sample.

Surface material samples will be collected as follows:

1. At each sample location (for grab samples) or sub-sample location (for composite samples), clear an area of surface vegetation, non-decomposed plant litter, and debris that is approximately 30 centimeters in diameter
2. In the cleared area, use a decontaminated stainless steel spoon or hand auger to collect material to a depth of 5 centimeters. A stainless steel pick may be used as needed to loosen the soil.
3. Visually describe the material and record observations on the field sample form.
4. Place the material into a decontaminated stainless steel mixing bowl. Mix thoroughly.
5. At each incremental sample location for a given composite sample,, repeat Steps 1 through 4, adding each successive incremental sample to the mixing bowl.
6. Thoroughly mix the sample material in the stainless steel bowl using a decontaminated stainless steel spoon. To homogenize the sample, divide the sample into four quarters and mix each quarter individually, then recombine the four quarters and mix the entire sample. Place the homogenized sample into the appropriate laboratory-supplied sample containers.
7. Label and handle the containers as specified in SOP No. 2, Sample Management.
7. Take GPS survey reading (SOP 3), record it along with the coordinate system used.
8. Take a digital photograph of the outcrop (SOP 4) with a scale bar.
9. Fill out field sample form and chain of custody form (SOP 2).

Sub-surface material samples will be collected as follows:

1. At each sample location, clear an area approximately 30 centimeters in diameter of surface vegetation (non-decomposed plant litter) and debris.
2. Use a decontaminated stainless steel spoon, shovel, or hand auger to collect subsurface material from the surface to a depth of 2 feet below ground surface. A stainless steel pick may be used as needed to loosen the soil. To the extent possible, eliminate gravel-size or larger particles and debris based on visual observation. Place the material in a stainless steel mixing bowl. The material placed in the bowl should be representative of the entire depth horizon (i.e., 0 to 2 feet).
3. Visually describe the material and record observations on the field sample form.
4. Place the material into a decontaminated stainless steel mixing bowl. Mix thoroughly using a decontaminated stainless steel spoon.
5. To homogenize, divide the sample into four quarters and mix each quarter, then recombine the four quarters and mix the entire sample. Place mixture into appropriate laboratory-supplied sample containers.
6. Label and handle the containers as specified in SOP 2.
7. Take GPS survey reading (SOP 3) and record it along with the coordinate system used.
8. Take a digital photgraph of the outcrop (SOP 4) with a scale bar.
9. Fill out field sample form and chain of custody form(SOP 2).

5.6 UNDISTURBED SOIL SAMPLES (BLOCKS)

Purpose
Sampling undisturbed soils

Equipment list for undisturbed samples
- Preparation knives
- Spatulas
- Wire saws
- Stainless steel pick
- Surveying stakes, lath, paint, or flags
- Foldable wood box to store the sample
- Fabric or cloth (large enough to wrap the whole sample block)
- Paintbrush
- Paraffin
- Apparatus to melt the paraffin
- Wet sawdust
- Measuring tape
- Health and Safety equipment as outlined in the Site-Specific Health and Safety Plan
- Bound weatherproof field logbook
- Field sample data sheets
- Weatherproof labels and permanent markers
- GPS unit (SOP No. 3) set to correct coordinate system.
- Decontamination equipment (SOP 7)
- Digital camera

Sampling procedures
Sampling equipment should be acid-washed and thoroughly rinsed with deionized water prior to use in the field and decontaminated between samples (SOP 7).

i) Shape and dimensions of the block
The undisturbed block must have a cubic shape with side length ranging from 0.5 foot (0.15 meter) to 1.31 foot (0.40 meter), depending on the laboratory requirements.

ii) Collection of block from the bottom of the excavation
a. Avoid sample locations where large cobbles can be identified, as big rocks might impede sample molding.
b. From 4 inches above the top of the intended block, carefully excavate using the same tools that will be used to mold the block.
c. Once you reach the point where the top of the excavated block will start, excavate laterally around the edges of the block down to 4 inches below the intended base level of the block.
d. Identify the top of the block by marking it with the letter “T”.
e. Wrap the exposed faces of the block with a cloth and apply a layer of liquid parafin on the outside of the cloth using a paintbrush. Repeat the paraffin-coating procedure at least twice. Special care must be taken with cohesionless soils as the

block must be reinforced with extra layers of cloth and paraffin before the base can be sectioned.

f. To section the base of the block, turn it onto a soft soil cushion and trim the base to the planned dimensions. Cover the face with layers of cloth and liquid paraffin as done for the other faces.
g. Before applying the last layer of paraffin, a label must be placed on the top of the block containing the following information: location, test pit number, date, block number, top and base depths, and block orientation (i.e. north – south).
h. If possible, place the block into the wooden box and pack it while you are still in the test pit. The wooden box should be 2 inches wider than the block and have foldable faces. The bottom of the wooden box must contain a 1-inch layer of wet sawdust and the spaces around the block in the wooden box must be filled with the same material. Alternatively, take the coated sample carefully to the surface and place it into the cubic wooden box and pack it with the sawdust.
i. The top of the wood box must be tagged with the same information as the label placed onto the top of the sample.
j. The procedures described above must be followed without interruption, avoiding direct sunlight or water incidence on the block (i.e. If you need to take a break, don't start the next sample until you get back).
k. Refer to SOPs 2 and 36 to preserve and ship the collected blocks, including filling out the sample form and chain of custody forms.

iii) Collection of blocks from the cut wall

a. Excavate a space large enough to allow the molding of the sides and top of the block.
b. Excavate into the wall following the direction of each face. The excavation of the side faces must be 2 inches wider than the desired dimension of the block.
c. Identify the top of the sample by marking it with the letter "T".
d. Wrap the front, sides, and top faces of the block with a cloth and liquid paraffin as described above.
e. Section the back and inferior (bottom) faces of the block and place it carefully on a soft soil cushion, keeping the faces without paraffin exposed. Trim the faces to the planned dimension.
f. Wrap the exposed faces with a cloth and liquid paraffin as done for the other faces of the block.
g. To finish sampling, follow the same procedures described above in steps 2g-2k and collect blocks from the bottom of the excavation.
h. Refer to SOP 36 and SOP 2 to preserve and ship the collected blocks.

iv) Field documentation

The sampling process must be documented in the field sheets and field book. Digital photographs showing the sampling process and the location of the samples in the test pit with a scale bar should always be taken (SOP 4). A GPS survey reading (SOP3) should be taken and recorded along with the coordinate system used.The following information must be included:

- Purpose and destination of the samples

- Test pit identification
- Date of sampling
- Sampling personnel
- Number of blocks collected along with specific depths (to top and base of sample), sample orientation and location (cut wall or bottom of the excavation)
- Description of the material (grain size, weathered, layered, etc)
- Sketch of the sample location with dimensions.
- Description of the weather at the time of collection (sunny, rainy, snowy, temperature, etc.)
- Make notes concerning any problem faced during the sampling (removal of large cobbles, difficulty cutting the faces, fragmentation of the sample, etc)

5.7 SUBSURFACE SOIL SAMPLING WITH HAND AUGERS

Purpose
Sampling subsurface soils.

Equipment list
The following is a list of equipment that will be necessary to perform subsurface soil sampling using a hand auger:

- Stainless steel hand auger with handle extensions
- Stainless steel bowls
- Stainless steel spoon, scraper, or other tools for use in extracting soil samples from the auger barrel
- Health and Safety equipment as outlined in the Site-Specific Health and Safety Plan
- Appropriate sample containers and weatherproof labels
- Surveying stakes, lath, paint, or flags
- Stainless steel bowl
- Sample containers
- Measuring tape
- Bound weatherproof field logbook and indelible pens
- Sample field data sheets
- Decontamination equipment (SOP 7)

Sampling procedures
Prior to sampling, hand auger borings will be numbered and the site cleared for utilities by Molycorp personnel as specified. Boring locations may be adjusted in the field due to the presence of underground utilities or other structures, or if access problems are encountered. Hand auger locations will be approved by the Project Manager prior to initiating sampling activities. Sampling procedures are as follows:

- Health and safety equipment specified in the site-specific HSP will be donned before proceeding with subsurface sampling activities.
- All hand auger cuttings will be placed in labeled buckets and moved to a central secure location for storage. Any water generated during augering will be retained in

labeled containers. If required, handling of investigation derived wastes (IDW) will be as specified by Molycorp personnel.
- Hand augers will be cleaned prior to proceeding to the sampling site and between subsequent boreholes using the procedures presented in SOP 7.

Sample collection
Soil samples will be collected at the locations and depths specified in the FSP. The following procedure will be used for collecting soil samples with the hand auger and a drive sampler or other appropriate sampler. Successively deeper drives of the sampler may be required to obtain sufficient volume of material to meet analysis requirements.

Hand Augering Procedures
1. Decontaminate the hand auger and associated sampler in accordance with SOP No. 7, Decontamination of Sampling Equipment.
2. Clear the borehole location of surface debris (e.g. gravel, vegetation, etc.)
3. Attach the auger bit to the drill rod extension, and attach the T-handle to the drill rod.
4. Begin augering, periodically removing and depositing accumulated soils onto a plastic sheet spread near the hole. This prevents accidental brushing of loose material back down the borehole when removing the auger, and avoids possible contamination of the surrounding area. Following completion of hand augering and sampling at a location, transfer this material to a covered sample bucket with sample labels and chain of custody forms.
5. After reaching the desired depth, slowly and carefully remove the auger from the boring. Remove by hand any soil that falls back into the borehole as the auger is removed.
6. Once all the required sample material is collected, thoroughly mix the sample material in the stainless steel bowl using a decontaminated stainless steel spoon. To homogenize, divide the sample into four quarters and mix each quarter individually, then recombine the four quarters and mix the entire sample. Place mixture into appropriate laboratory supplied sample containers.
7. Label and handle the sample containers in accordance with SOP No. 2, Sample Management.
8. Take GPS survey reading (SOP 3) and record along with coordinate system used.
9. Take a digital photograph of the outcrop (SOP 4) with a scale bar.
10. Fill out field sample form and chain of custody form (SOP 2).

5.8 TEST PIT, TRENCH, AND HIGH WALL SAMPLES

Purpose
Obtain samples from test pits, trenches, and high walls.

Equipment list

The following materials and equipment may be needed for the excavation and sampling of test pits, trenches, and high walls:

- Bound weatherproof field logbook
- Indelible black-ink pens
- Digital camera
- Tape measure
- Backhoe
- Shovels, picks, or scoops
- Teflon bailer and nylon cord
- Protective clothing and equipment, as required
- Appropriate field monitoring instruments
- Health and safety equipment (and protective clothing) as outlined in the Site-Specific Health and Safety Plan (HASP).
- Decontamination supplies and equipment (e.g., high pressure sprayer/washer, wash/rinse tubs, brushes, liquinox, plastic sheeting, paper towels, sponges, baby wipes, garden-type water sprayers, large plastic bags, potable water, distilled or deionized water)
- Appropriate sample containers, weatherproof labels, coolers, ice (or ice substitute), field sample and chain-of-custody (COC) forms, as specified in the FSP
- Stainless steel trowels, scoops, bowls, and knives
- Stainless steel slide hammer drive sampler with extension rods, stainless steel tubes, Teflon® sheeting, and plastic caps
- Drums or other approved water-tight containers for containment of water if pit/trench dewatering is required
- Plastic sheeting for holding and covering excavated materials

Sampling procedures

The FSP may require sampling of subsurface soil and/or buried materials for petrographic and chemical analysis. Unless otherwise specified in the FSP, subsurface soil and buried material samples will be collected from the excavated material removed from the test pit/trench.

Samples of excavated material will either be collected at discrete depths or as composite samples over a vertical interval, as specified in the FSP. In either case, a composite sample of each backhoe bucket will be obtained by collecting five increment samples per bucket.

Selected samples of well-cemented material can be collected specifically to examine the cementation.

For discrete depth samples, one composite sample will be obtained from the backhoe bucket corresponding to the depth of interest. For vertical composite samples, one composite sample will be obtained from each of the successive buckets excavated from the depth interval of interest. Those successive bucket samples will then be combined to form the vertical composite sample.

Procedures for collecting soil samples at discrete depths for chemical analysis will involve the following steps:

1. Remove a bucket of material from the desired depth.
2. Use a decontaminated stainless steel scoop or trowel to collect 5 incremental samples of equal volume from the excavated material. Make sure that a sufficient volume of sample has been obtained to meet analysis sample volume requirements, in case it's the only bucket taken from that interval.
3. Combine the incremental samples in a decontaminated stainless steel bowl and mix thoroughly.
4. In selected areas decided upon by field-based discussion, collect undisturbed soil samples for electron microprobe analysis using containers provided by lab.
5. Take GPS survey reading (SOP 3) and record it along with the coordinate system used.
6. Take a digital photograph of the outcrop (SOP 4) with a scale bar.
7. Fill out field sample form and chain of custody form (SOP 2).
8. Label and handle the containers as specified in SOP 2 Sample Management.
9. Decontaminate the sampling equipment in accordance with SOP 7. Decontamination of Sampling Equipment.

Procedures for collecting vertical composite samples for chemical analysis will involve the following steps:

1. Remove a bucket of material from the uppermost portion of the vertical interval of interest.
2. Use a decontaminated stainless steel scoop or trowel to collect 5 increment samples of equal volume from the excavated material. Make sure that sufficient volume of sample is collected to meet analysis sample volume requirements.
3. Combine and mix the increment samples thoroughly. Because the number of buckets for the entire vertical interval of interest may be unknown, enough sample material should be collected from the material in the first bucket to make sure you obtain the necessary volume of sample for analysis in case it's the only bucket from that interval.
4. Excavate the next bucket from the vertical interval of interest. Collect the same volume of material from the bucket as in Step 3 and add the incremental samples to the mixture in the stainless steel bowl. Mix thoroughly with a stainless steel spoon or trowel.
5. Repeat Step 4 for successive buckets until the base of the vertical interval of interest is reached.
6. Fill the appropriate sample containers, as specified in the FSP, from the mixture.
7. Label and handle the containers as specified in SOP 2.
8. Decontaminate the sampling equipment in accordance with SOP No. 7 Decontamination of Sampling Equipment.

9. Take GPS survey reading (SOP 3) and record it along with the coordinate system used.
10. Take a digital photograph of the outcrop (SOP 4) with a scale bar.
11. Fill out field sample form and chain of custody form (SOP 2).

5.9 ROCK PILE CHANNEL OR TRANSECT SAMPLING

Purpose

This method is to be used when road-cuts, trenches or other kinds of profiles are exposed.

Equipment list

The following is a list of equipment that will be necessary to collect samples from trench or high walls:

- Stainless steel spade or shovel
- Pick
- Stainless steel bowls
- Health and Safety equipment as outlined in the Site-Specific Health and Safety Plan
- Appropriate sample containers, weatherproof labels, and indelible pens
- Bound weatherproof field logbook
- Sample field data sheets
- Decontamination equipment (SOP 7)

Sampling

1. For the purpose of the sampling, we will consider fine grain particles as matrix and pebbles and boulders as lithoclasts.
2. Scrape a 20-50 by 30-70 cm area to remove the surface weathering layer. The size of the area depends on layer thickness. In the case of stratification and/or the presence of lithoclast-sized grains, no single lithoclast should occupy more than 20% of the total sampling area.
3. Estimate relative proportions of matrix and lithoclasts.
4. Estimate matrix grain size.
5. Estimate lithoclast grain sizes. In case of polymodal distribution, determine and record proportions for each lithoclast population.
6. Take a digital photograph of the sampling area with a scale bar.
7. Use Munsell chart for matrix and lithoclast colors.
8. Extract a 20-50 x 30-70 x 10-20 cm sample or a 10-20 kg sample.
9. Selected samples of well-cemented material can be sampled specifically to examine the cementation.

10. Take GPS survey reading (SOP 3) and record it along with the coordinate system used.
11. Take picture of the outcrop (SOP 4).
12. Fill out field sample form and chain of custody form (SOP 2).

5.10 SELECT SAMPLES FOR SPECIFIC ANALYSES

Some samples will require special handling because of the requirements for special analyses (i.e. surface crusts, moist samples). Standard operating procedures will be developed for these samples and be included in this or separate SOPs.

5.11 SAMPLE ARCHIVAL AND DISPOSAL

As described in the QAPP and FSP, a portion of all solid samples will be collected and archived at NMBGMR or the mine for potential future evaluation. Groundwater, surface water, and microbe sample aliquots will not be archived as a part of the study for future analysis or consideration. Any water sample volume not consumed during sample analysis will be disposed of by the laboratories as described in the laboratory QAM in accordance with all applicable rules and regulations.

6.0 DECONTAMINATION OF SAMPLE EQUIPMENT

Sample equipment must be decontaminated between collection of each sample using available appropriate means (SOP 7). At a minimum, equipment must be brushed and wiped clean after each sample. Compressed air, acetone, or deionized water can be used in some cases. Use of heavy weight latex gloves to protect hands when collecting is recommended for all sampling.

7.0 FIELD QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES AND SAMPLES

QA/QC samples are designed to help identify potential sources of sample contamination to evaluate any potential error introduced by sample collection and handling. All QA/QC samples will be labeled and sent with the other samples to the laboratory for analysis. The type and number of QA/QC samples are defined in SOP 2 Sample Management.

8.0 SAMPLE MANAGEMENT

Each sample is assigned a unique field identification number. A chain of custody form will be completed and sent with each sample batch.

The field identification (ID) number for samples will be comprised of three components separated by dashes, for example SSW-HRS-0001, as described below.

Field identification Number (Field id)

Component 1	Component 2	Component 3

Three letter abbreviation for the mine feature, for example SSW for Sugar Shack West.	Three letter initials of the sample collector, for example HRS for Heather R. Shannon.	Sequential four number designation, for example 0001.

Each sample is then assigned a separate sample identification number during sample preparation. The first part is identical to the field identification number and is followed by a sequential two numbers, for example SSW-HRS-0001-01.

Sample identification Number (Sample id)

Component 1	Component 2	Component 3	Component 4
Three letter abbreviation for the mine feature, for example SSW for Sugar Shack West.	Three letter initials of the sample collector, for example HRS for Heather R. Shannon.	Sequential four number designation, for example 0001.	Sequential two number designation, for example 01.

Any deviations from this sampling numbering system will be documented and reported to the Team Leader and Principle Investigators.

9.0 DOCUMENTATION

Field notes

Documentation of observations and data acquired in the field will provide information on the acquisition of samples and also provide a permanent record of field activities. The observations and data will be recorded on field sample forms and field logbooks and consequently entered into the database. All information on field forms must be completed.

If samples are held for an extended period of time (i.e., inadvertently missed Fed-Ex pick up), field personnel will document all sample handling and custody on field sample and COC forms and entered into the database.

Samples in the field are assigned a field identification number. After samples are prepared, a sample identification number is assigned. A one-to-many relationship exists between field identification number and sample identification number.

10.0 REFERENCES

APPENDIX I. FORMS (See forms in Molycorp Access Database)

- Sample_anal_request_form

- Sample field form
- Sample_preparation form
- Drillhole form
- Drill_hole_log
- See database for current versions of forms