

STANDARD OPERATING PROCEDURE NO. 1.6**DATA MANAGEMENT**

REVISION LOG		
Revision Number	Description	Date
1.0	Original SOP	4/5/03
1.1	Comments VTM	10/19/04
1.2	Renumbered JRH	10/19/04
1.3	Additional comments incorporating U of U contribution by ADS	10/25/04
1.4	Rewrites by MWS	12/23/04
1.5	Incorporating changes by JRH and GMLR	1/13/05
1.6	Change by VTM addressing GMLR	1/28/09

1.0 PURPOSE AND SCOPE

This Standard Operating Procedure (SOP) provides technical guidance and procedures to manage and deliver the data collected for the Molycorp Questa Mine rock characterization project (here after referred to as the Molycorp project). The various aspects of data management as they relate to the tasks of data collection, derived datum, and data validation are discussed. An overview of the database infrastructure is given in Section 7.

2.0 RESPONSIBILITIES AND QUALIFICATIONS

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

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

3.0 RELATED STANDARD OPERATING PROCEDURES

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

Number	Name	Description
MP	Project Management Plan	Overall project management plan
WP	Work plan	Work plan for the project
HASP	Health and Safety Plan	Health and safety plan for field and laboratory work
QAPP	Quality Assurance Project Plan	Quality assurance and quality control plan
FSP	Field Sampling Plan	Field sampling plan
DP1	Drilling plan, phase 1	Drilling plan
DP2	Drilling plan, phase 2	Drilling plan
GMP	Geologic mapping plan	Geologic mapping plan
SOP 1	Data management	entering, reporting, verification, and validation of data to the database
SOP 2	Sample management	procedures of handling samples from field to laboratory to archive
SOP 3	Surveying (GPS)	field procedures using GPS and other surveying methods
SOP 4	Photography	procedures taking photographs in the field and laboratory
SOP 5	Sampling outcrops, rock piles, and drill core	field procedures for taking surface solid samples
SOP 6	Drill logging and sampling of subsurface	field procedures for drilling, logging, and sampling of subsurface samples (solids)
SOP 7	Sample equipment Decontamination	field procedures for decontamination of sampling equipment
SOP 8	Sample preparation	laboratory procedures for sample preparation (solids)
SOP 9	Test pit excavation, logging, and sampling (solid)	field procedures for test pit excavation, logging, and sampling (solid)
SOP 10	Met station maintenance	field procedures for maintaining meteorological station
SOP 11	Paste pH and paste conductivity	laboratory procedures for paste pH and paste conductivity
SOP 12	Field measurements of water	field procedures for measuring water flow, pH, conductivity, alkalinity, temperature when collecting water samples
SOP 13	Water elevation measurements	field procedures for measuring water elevations in drill holes
SOP 14	Field filtration of water samples	procedures for filtering water samples in the field
SOP 15	Surface water and seep sampling	field procedures for collecting samples of surface and seep water samples
SOP 16	Groundwater sampling	field procedures for collecting ground-water samples
SOP 17	Borehole logging	field procedures for borehole logging

Number	Name	Description
SOP 18	Pump testing	field procedures for collecting information during pump testing
SOP 19	Geophysical logging	field procedures for borehole geophysical logging
SOP 20	Well development	field procedures for development of wells
SOP 21	Monitoring well installation	field procedures for installing monitoring wells and instrumentation
SOP 22	Analytical data validation	procedures for data validation
SOP 23	Geophysics with electromagnetic induction	procedures for geophysical surveys
SOP 24	Petrographic analysis	laboratory procedures for describing petrographic samples
SOP 25	Stable isotope analysis	laboratory procedures for stable isotope analyses
SOP 26	Electron microprobe analyses	laboratory procedures use for analyses using the electron microprobe
SOP 27	X-ray diffraction (XRD) analyses	laboratory procedures for mineralogical analyses by x-ray diffraction (XRD)
SOP 28	X-ray fluorescence (XRF) analyses	laboratory procedures for chemical analyses by x-ray fluorescence (XRF)
SOP 29	Clay mineralogy analyses	laboratory procedures for sample preparation and XRD analyses of clay minerals
SOP 30	ICP-OES analyses	laboratory procedures for chemical analyses using ICP-OES
SOP 31	ICP-MS analyses	laboratory procedures for chemical analyses using ICP-MS
SOP 32	Bulk density	laboratory procedures for determining bulk density
SOP 33	Particle size analysis	laboratory procedures for determining particle size analyses
SOP 34	Sampling for the Remaining Pyrite Model	approach, collection of samples and laboratory procedures required for sampling for remaining pyrite model
SOP 35	Volumetric moisture content	collection of samples and laboratory procedures for determining volumetric moisture content
SOP 36	Sample preservation, storage, custody, shipping	procedures for sample preservation, storage, and shipment
SOP 38	DI leach	laboratory procedures for leaching solid samples by deionized water to provide for soluble material
SOP 39	Samples for Pore water measurements	laboratory procedures for collecting samples for pore water measurements
SOP 40	Gravimetric moisture content	collection of samples and laboratory procedures for gravimetric moisture content
SOP 41	Reflectance spectroscopy	field procedures for mineralogical analyses using reflectance spectrography
SOP 42	Porosity	laboratory procedures for determining porosity
SOP 43	Tensiometer and thermal conductivity thermal conductivity sensor installation	field procedures for installing tensiometers and thermal conductivity sensors procedures for argon/argon dating
SOP 44	Argon/argon geochronology	laboratory procedures for argon/argon dating
SOP 45	Moisture retention relation by hanging column	procedures for determining moisture relations
SOP 47	Rain and snow collection for isotope	field procedures for collecting rain and snow
SOP 48	Dye tracer studies	Tracer studies using dyes
SOP 49	Chip tray preparation	How to prepare chip trays of drill cuttings for examination
SOP 50	Direct Shear tests	How to do simple shear box tests

Number	Name	Description
SOP 51	Collecting Thermal images	How to collect thermal images using thermal camera
SOP 52	Static Net Acid Generation (NAG) Test	Nag test for laboratory
SOP 53	Tension Infiltrometer	procedures for tension infiltrometer measurements
SOP 54	Atterberg Limits	procedures for Atterberg Limits
SOP 55	General Microbial Sampling - Solids	General Microbial Sampling - Solids
SOP 56	Classical microbial analysis - solids	Classical Microbial Analysis - Solids
SOP 57	Microbial laboratory safety	Microbial Laboratory Safety
SOP 58	Microbial metabolic profiles - biology	Microbial Metabolic Profiles - Biology
SOP 59	Microbial nucleic acid analysis	Microbial Nucleic Acid Analysis
SOP 60	Slurry pH-redox-conductivity-temperature	Slurry Ph – Redox – Conductivity - Temperature
SOP 61	Neutron density gauge	Describes measurements taken with the nuclear density gauge (density, water content)
SOP 62	Acid-base accounting (ABA)	Procedures for acid base accounting in laboratory
SOP 63	Kelway soil acidity and moisture measurements	Kelway Soil Acidity and Moisture Tester for field measurements
SOP 64	Portable tensiometer	procedures for using field portable tensiometers as opposed to in place monitoring
SOP 65	Sandcone	procedures for sand cone
SOP 66	Gas analyzer	procedures for gas analyzer
SOP 67	Solid sample collection and compound analysis	procedures for solid sample collection and compound analysis
SOP 68	Water analyses	water analyses in lab
SOP 69	Other chemical analyses on solids	other chemical analyses on solids (ammonia, nitrate, fluorine, etc)
SOP 70	Sand replacement	calculates volumetric moisture content and bulk density
SOP 71	Guelph permeameter	procedures for guelph permeameter measurements
SOP 72	SWCC	Soil water characteristic curve (UBC)
SOP 73	Falling head Permeability	Permeability by falling head method
SOP 75	Specific gravity	procedures for determining specific gravity
SOP 76	Slake durability	procedures for slake durability tests
SOP 77	Point load	procedures for point load tests
SOP 78	Humidity cell testing	procedures for weathering cells tests
SOP 79	Sample preparation for humidity cell testing	procedures for weathering cells sample selection and preparation
SOP 90	XRD sample preparation for pyrite reserve model	XRD sample preparation for pyrite reserve model
SOP 91	Color	procedures for obtaining the color of a soil sample

4.0 EQUIPMENT LIST

The following equipment and facilities comprise the main elements of the data management infrastructure:

- Microsoft (MS) SQL Server (version 2000 standard edition or comparable)
- Server-class computer system(s)
- Secure data connections between various electronic data sources
- MS Access forms, queries, and reports approved by New Mexico Bureau of Geology and Mineral Resources (NMBGMR) or the DIGIT Lab at the University of Utah (DIGIT Lab)

- Laboratory specific electronic document templates, such as those associated with Microsoft Excel spreadsheets
- Printed forms and reports

5.0 PROCEDURES

The following procedures are intended as guidelines for producing accurate, reliable datasets from which the Molycorp project database may be derived. Practices and procedures associated with activities specific to field or laboratory data collection, reduction, **verification, validation and reporting** will be established by each Principal Investigator (PI) and will be addressed in the appropriate SOP(s).

Although the procedural specifics will vary between laboratories, equivalent procedures have been performed by each laboratory performing the same analysis in order to maintain data quality.

The central data repository during the term of the project was NMIMT (V.T. McLemore, manager). Once the project was concluded, the data were copied onto a University of Utah web site and another copy will be sent to Chevron Mining Inc. NMIMT will continue to maintain the data repository since there will be several on-going investigations past the end of the project.

5.1 Data Collection

- Each principal investigator (PI) will be responsible for the data produced under their respective authority.
- Each PI or their designated representative will have authorization to enter data into the database, in accordance with relevant SOPs. Most PIs elected to have K. Donahue, V.T. McLemore, or M. Smith enter their data. L. Heizler and N. Dunbar entered their data directly into the database.
- Data will undergo a data validation prior to entry into the database.
- Field measurements, lithologic data, and sample collection information will be recorded by field personnel for use and reference before being entered into the project database.
- Electronic and hard copy data received from laboratories will be tracked by the appropriate PI for completeness of delivery and entered in the project database. Care must be taken to ensure that all laboratory data are received and documented.
- Original copies of field forms will be retained with the central project files at NMBGMR. Copies should be made and stored in a separate location by each PI in order to prevent the destruction of information.
- Any changes in data after the initial entry shall be requested only by the PI, and the change, date and reasons for the change will be sent to the Project Manager.

5.2 Derived Data

- The PI will be responsible for assuring that the data reduction is performed in a manner that produces quality and reproducible data.
- Both the originator and any person acting as a data auditor are responsible for the correctness of calculations.
- Calculations will be peer-reviewed for both method and arithmetic by an independent party.
- The data auditor will be accountable for the correctness of the checking process. After ensuring mistakes have been corrected, the data auditor will sign and date the calculation sheet immediately below the originator.
- Hand calculations will be recorded on calculation sheets and will be legible and in logical progression with sufficient descriptions. Care must be taken so that critical data are not lost or data quality diminished, including such attributes as significant digits or units of measurement.

The following information will be recorded for each major calculation or a series of calculations, as applicable:

- project title
- brief description of the task
- task number, date performed, and signature of person who performed the calculation
- basis for calculation
- assumptions made or inherent in the calculation
- complete reference for each source of input data
- methods used for calculations, including reference
- results of calculations, clearly annotated
- problem statement
- input data clearly identified
- list of variables

5.2.2 Data Reduction

The laboratory analyst is responsible for the reduction of raw data, and the analyst's name will be recorded with the laboratory data. For many methods, data reduction software is included with the instrument or Laboratory Information Management System (LIMS), if available. In those cases, the analyst must verify that the data reduction was correct. The system can require manual manipulation, which should be recorded, dated and signed, to correctly calculate sample concentrations.

The analytical process includes a Quality Assurance (QA) review of the data, which will differ between laboratories. Specific requirements, acceptance criteria, and corrective actions for each analysis are included in the analytical methods/SOPs. The checks are reviewed at several levels by laboratory analysts, supervisors, designated QA specialists, and/or document control staff. After the data have been reviewed and verified, the laboratory reports are signed and released for distribution. Data will be validated before entry and after entered by hand.

Laboratories should use a LIMS, if available, to electronically track and report sample and QA data. The data are reported electronically from the LIMS to the project staff using pre-established formats. The LIMS files must also undergo a QA check to verify that the results are complete and correct, and that the files are properly formatted.

Due to lack of funding a LIMS system was not established at NMIMT.

5.3 Data Analysis

Computer analyses include the use of models and programs. Both systematic and random error analyses will be investigated and appropriate corrective action measures taken by the PI. The PI will evaluate, determine applicability, and document the use of automated data reduction techniques if needed on this project.

Quality Control (QC) procedures for checking models (or programs) will involve reviewing the documentation, running the test case, and manually checking selected mathematical operations. Each computer run used to check a model or program will have a unique number, date, and time associated with it appearing on the printout.

5.4 QA/QC

Data that are manually entered from logbooks or field forms into a computer file will be verified by the PI or the PI's designated representative for correctness after data entry. Similarly, data that are transcribed from one logbook or field form to another will be verified for correctness after data transcription for correctness. Data received electronically will be reviewed for obvious signs of corruption and information loss prior to use by internal checking functions within the database. PIs will be notified of any abnormalities indicated by this internal checking.

Derived data will be checked to verify the result. A minimum of 5% of the records transformed will be validated. If errors are found in the transformation process, 100% of the records that were transformed must be verified and corrected as needed.

The assurance that the method, instrument, or system performs its intended function in a consistent, reliable, and accurate manner while generating data is achieved through the validation and verification of the resulting analytical data.

A summary of QA/QC procedures is by McLemore and Frey (2008).

5.5 Data Security

Specific data security practices will vary between the various organizations. In general, the following items should be represented in each organization's data security policies:

- **Individual authentication of users-** The practice of shared access limits the ability to audit transactions to the site, not the individual. The ability to track a transaction to a particular individual will greatly reduce the time required to correct errors in the database and should be avoided.
- **Access controls-** Retrieval of documents is limited to personnel who have been granted access by the Project Manager.
- **Audit trails-** As part of the audit data, project correspondence file should be maintained by each PI. It is the PI's responsibility to assure that project personnel comply with this requirement. As with individual user authentication, the primary motivation for maintaining audit trails is to improve the ability to resolve errors in the database.
- **Physical security and disaster recovery-** Sensitive or final electronic documents may be further protected to prevent inadvertent changes. Each individual should maintain a backup of the critical information that they produce. In addition, a backup of information will be performed on key systems in the data management infrastructure.
- **Protection of remote access points-** Workstations with active database sessions should be (electronically) locked whenever unattended.
- **Protection of external electronic communications-** For the transmission of particularly sensitive project information, the information should be secured either by transmission over a secure channel before transmitting over a non-secure medium (such as the Internet). In such cases, the Project Manager should be consulted prior to transmitting information.
- **Software discipline-** A procedure/software for detection and elimination of computer viruses, Trojan horses, and spyware should be installed on any computer used on the project, and on the central data storage servers at the University of Utah and NMIMT.
- **System assessment-** An assessment of system and network security should be performed by qualified personnel at key data storage facilities.

Sources for some useful software utilities related to data security are listed in Appendix A.

6.0 MISUSE OF DATA

Chemical data provided in the database must be used with extreme caution. Some of the chemical data reported represent select samples from the mine collected for specific ongoing research purposes and are not always representative of the mineral deposit, environmental impacts, or relevant for regulatory requirements. When other agencies or individuals have collected data, this information will be so entered and cited as appropriate. Metadata are in the access database that identifies the source of the data.

7.0 DATA MANAGEMENT INFRASTRUCTURE

The data management infrastructure is an assemblage of database servers and network connections that provide a reliable means by which data generated for projects such as the Molycorp project can be distributed securely to the end users. Figure 1 illustrates the main components of the data management infrastructure.

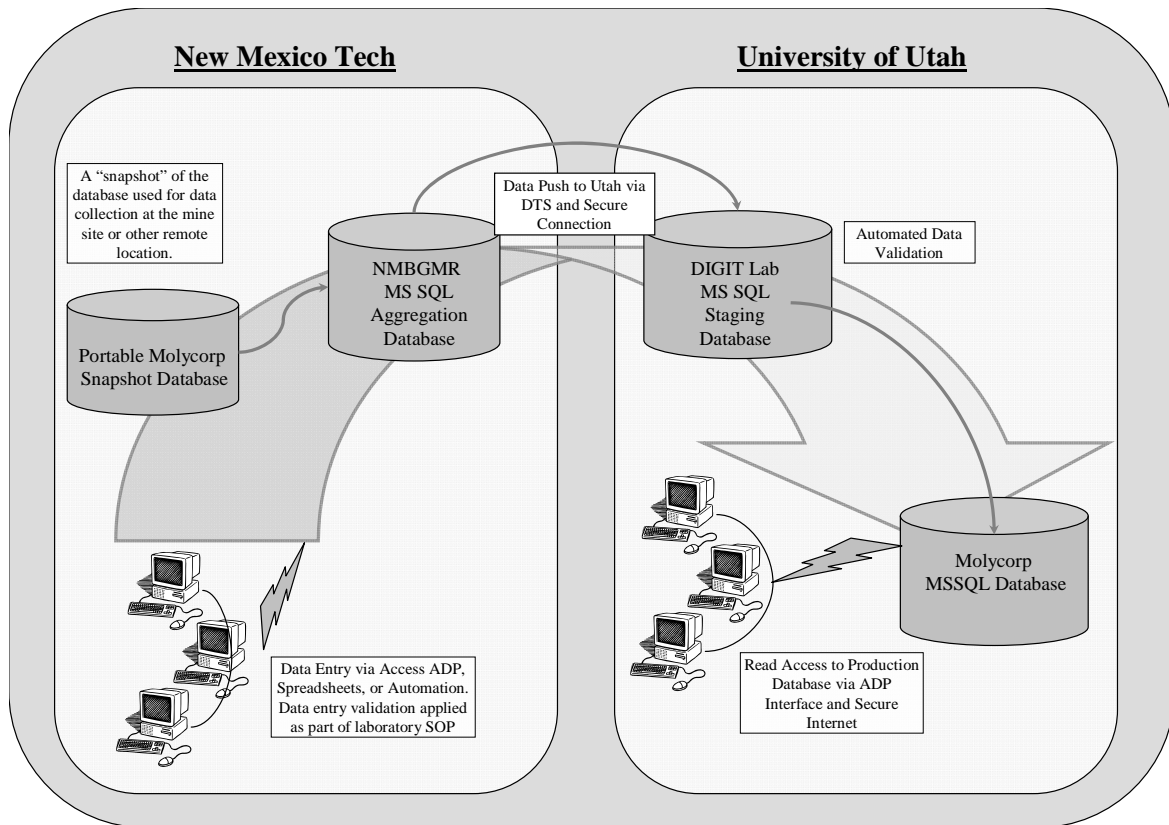


Figure 1: Data Management Infrastructure

7.1 System Design

The core data management infrastructure consists of three MS SQL database servers interconnected via secure internal Local Area Networks (LAN) at NMBGMR and the DIGIT Lab. A secure, encrypted data channel established between these two facilities over the Internet links these three systems.

7.1.1 Data Aggregation

The database server located at NMBGMR functions as a data aggregation point for all incoming data from the PIs for the Molycorp project. Data undergoes any QA/QC procedures specified in the related SOPs before and during data entry. Preliminary validation is imposed on the data as it is being entered in order to screen for data entry errors.

Data entry is accomplished by several means, including:

- Direct data entry via MS Access forms provided through the Access Data Project (ADP) file. This method gives PIs the ability to perform data entry directly into the aggregation database.
- Electronic data file submission to the Molycorp project database manager at NMBGMR. Data submission can be accomplished by several methods, such as secure FTP or mailing a CD ROM containing the data files.
- Automation allowing laboratory systems to directly enter data into the aggregation database.
- Use of a portable database application using a current “snapshot” of the validated Molycorp project database available from the DIGIT Lab. By this means a PI has the ability to perform data entry at remote locations using a facsimile of the current database. New data gathered into this portable database may be transferred to the aggregation database upon return from the field.

7.1.2 Database Staging

The second database server in the data management infrastructure located at the DIGIT Lab functions as a database staging area. Data gathered on the aggregation database server is transferred from NMBGMR to the DIGIT Lab through the Publish-Subscribe database replication feature of the MS SQL server. These two database servers communicate via a secure, virtual point-to-point connection. Other than database management personnel at the DIGIT Lab, no person will have direct access to the data on this system.

The staging database performs the second layer of validation administered under automated methods built into the staging database. Any record that fails validation will not be incorporated into the project database located on the next database server in the data flow. Flagged entries will be returned to the responsible PI for verification against the original data. Once the corrected data has been verified, it will be transferred to the project database.

7.1.3 The Production Database

The third database server in the data management infrastructure also located at the DIGIT Lab acts as the final repository for the working data set for the Molycorp project. This database contains project data that has passed all of the QA/QC checks and automated and manual validation that is built into the data management process. Information on this server is available to the PIs through the use of another Access ADP file. Data access to the production database is made available in a read only format to the end user. This ensures that data corruption cannot occur during normal user interaction.

If there is a need for any specific reports, the DIGIT Lab will, upon request, create reports that suit the needs of the PIs and Molycorp by incorporating the new reports into an updated ADP. The updated ADP will be sent to each PI and PI will be responsible for using the most current ADP for their reporting.

7.2 Data Security

7.2.1 Access Management

The project manager will control access authority to data by other PIs, project personnel, or outside parties. The project manager will approve changes in access authority.

Measures that will be taken to prevent unauthorized access to or modification of the database via the DBMS will include using secure network connectivity. Only those PIs who are given access will be able to read data from the project database.

The project database will be available to authorized users via read-only access from anywhere with a reliable internet connection using the provided Access Data Project (ADP) file. The ADP will be distributed only to the PIs on the project.

Other than entry of new data, any changes to the database are to be formally requested by a PI to the DIGIT Lab. The DIGIT Lab will verify all changes with the database manager for the Molycorp project at NMBGMR.

7.2.2 Backup and Data Archive

Laboratory data will be copied immediately upon receipt (or a second copy will be delivered by the laboratory) and the original placed in the data files. Information obtained from outside sources will be maintained in the project files only if the information is not publicly available. Data will be checked, validated, and entered into the project database as quickly as is practically feasible.

Electronic data and electronically generated reports and data interpretations will be stored on the project database at the University of Utah. The database will be backed up daily to avoid data loss.

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Appendix A

There are many software packages available to perform security functions. The following list contains an example of the types of software applications that perform useful security functions. Consult your IT department if you need assistance installing any of the following software packages. Some free license versions are available. If interested, please see details on each site to see if your organization qualifies for use of the free version.

Security Software Sources:

BitDefender virus scanner

<http://www.bitdefender.com/>

CWShredder- Detects the new Cool Web Search variants. Run before installing Spybot (below).

http://www.intermute.com/spysubtract/cwshredder_download.html

SpyBot Search & Destroy- Finds and eliminates Spyware on your computer.

<http://www.safer-networking.org/en/index.html>

PGP- file encryption software and utilities.

<http://www.pgp.com/> (US and Canada only- commercial users)

<http://web.mit.edu/network/pgp.html> (US and Canada only non-commercial and personal use)

<http://www.pgpi.org/products/pgp/versions/freeware/win32/6.5.8/> (International Version)

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