Letter of Interest for Homestake-DUSEL

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Developing an Internet-accessible database of 3D geologic and engineering data for Homestake

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Primary Collaborators

South Dakota School of Mines and Technology (SDSMT)

South Dakota Geological Survey (SDGS)

Homestake-Adams Research Center (HARC)

Description of the Project

Background and Science Goals

The Homestake mine has spent many millions of dollars gathering information about the mine, the geology, and the ore deposit. This information is critical to the development of the DUSEL facility and the needs of science researchers planning to use the lab. The gold has been removed from the mine, but a gold mine of information remains that can become an invaluable resource for engineers, scientists, and educators for many years to come. The transfer of a private mine and its data to a public facility represents a rare opportunity to create a unique public archive of considerable impact. These data must be protected, enhanced, and made available to those who need it. This effort must be initiated NOW to prevent the loss of information and make best use of this resource.

The preparation and utilization of the Homestake facility for deep underground science experiments requires that extensive information on the facility and its engineering and geological characteristics be made available to potential researchers and site development personnel. Detailed and easy access to the locations of shafts and drifts, in particular with respect to the surrounding county rock characteristics and the placement of wells and available core, will be required by engineers to safely implement the lab, and by scientists proposing potential research studies.

Much of this data currently exists in digital format employing a 3-D mine information system named Vulcan. This system is expensive and specialized and few potential users will be able to access the database in its present form. However, technology is readily available to convert this data and make it available over the Internet through standard Web browsers, allowing users to perform queries, make customized maps to suit their particular scientific and engineering requirements, and explore the data in three dimensions.

Several levels of access may be maintained in order to protect sensitive information: some portions of the data will be available to the general public, whereas additional portions needed by research and engineering staff can be placed under higher security. All levels may be stored within the same database and accessed through the same sets of browsers and software tools.

We propose to develop a comprehensive data storage and management plan for the Homestake-DUSEL geologic/engineering data and carry out the initial phases of data conversion and the development of access tools. Part of this effort includes identifying a long-term strategy for maintaining and updating the database and identifying the players involved. Failure to develop a coherent plan at the outset will reduce the availability and usefulness of the data, and leave this important data set vulnerable to loss or degradation over time.

The Homestake Data Gold Mine

Hundreds of millions of dollars have been spent in developing the extensive data holdings relating to the Homestake Mine and its three-dimensional characteristics. An initial inventory and organization of the data and core have been undertaken by Campbell and Campbell (Homestake Data Review Report, 2005). These data take many forms, but the most voluminous and critical spatial data include the following:

- Mine structures, including the open cut, shafts, drifts, ramps, stopes and other physical openings in the rock
- Facilities and utilities such as power lines, pumps, water lines, and equipment
- Thousands of drill holes and accompanying core holdings and logs
- Geologic data such as faults, formation contacts, ore body contacts, mineralization, fracture density, rock strength, gravity/magnetic surveys
- Surface structures above the mine, claim maps

Some of these data have been entered into a 3D mine data system named Vulcan, including the mine openings, surface structures, drill holes and certain geologic contacts and other features of interest. Some of this data is readily interpreted and used, but Homestake was a working mine with emphasis on production, and making the data understandable to external personnel was not a priority. Some of the information is cryptically encoded in shorthand form that will take time to sort through and render meaningful (Hladyz, pers.comm., 2005).

Additional information is available in physical rather than digital format. These holdings may be divided into spatial data, such as historical and modern plan maps, geologic

interpretations, cross sections, well logs, and fracture studies; and non-spatial data including property evaluation reports, progress reports, special reports, and reclamation data. The physical Homestake archives will become the property of the Homestake-Adams Research Center (HARC) who will take the responsibility for archiving these important materials and making them available for research.

Several barriers currently prevent getting the maximum benefit from this extraordinary data set.

- The Vulcan 3D system is expensive and complex. Few of the potential users of this data set will have the financial or training resources needed to explore the data and make it work for them. Easier and more accessible tools are needed to query and explore these data.
- The organization and even the extent of the physical data holdings are not well known. Extensive cataloging and sifting will be needed.
- Even after cataloging is complete, however, users need a way to link the physical data to the digital 3D mine structure. Designing a system to query and locate physical information and link it to the digital information will greatly facilitate the value of this data.

For example, an expert in gold mineralization systems might be preparing a proposal to study the thermal effects of mineralization in the mine. The proposal would become much stronger and have a greater chance of success if the geologist, from the comfort of his/her own office in California, might be able to gain the following information. Which physical mine openings intersect the areas of interesting mineralization? Which of the drill holes come within 100 meters of these mineralizations? Is the physical core for these holes still accessible, and how do I find it? If the core is gone, are the logs still there? What parts of the mine have the greatest density of holes with available core, and how do these areas overlap with the known mineralizations? What plan maps or cross sections are available in the archive that intersect this area of interest? This information helps the geologist locate the target areas that are most likely to yield a successful study.

Vision

We envision creating a long-term data management system for the Homestake data that meet the following critical needs:

- Creates a digital collection of important data that can be accessed remotely with common and inexpensive Internet-based tools, and that implements a tiered access approach with different data available at different levels of security.
- Designs a database structure that allows searching of the archives based on either attributes location, builds tools for performing advanced three-dimensional searches, and supports easy 3D visualization of the data.
- Links the physical data objects such as well logs, core, and paper maps to their corresponding locations in the mine, so that users may query what is available from the 3D digital framework. Ideally the most critical paper materials may be scanned so they may be viewed online once they are found.

- Lays out a long-term strategy for maintaining and updating the data as new information becomes available. The plan must include decisions about which entity or entities will be responsible for maintaining and serving the data, where the data will be housed, and how the long-term funding to support the database will be generated.

Tasks

Phase I. Designing and building the database enterprise (12-18 months)

- Inventory existing digital data, supplement description of features as needed, and begin converting data to ArcGIS formats. Initial conversion tests from Vulcan to ArcGIS have been successful. Develop metadata.
- Inventory physical data, link physical data to locational coordinates, and prioritize lists of data to be scanned for digital availability.
- Work with potential users and database experts to develop list of desired search/display strategies that will be needed, and identify which tools are already available and which will need to be programmed.
- Design database structure and build attributes needed for attribute and spatial queries.
- Develop database distribution plan and allocate responsibilities for serving the data, whether it will be located centrally or distributed over several sites. Identify entities responsible for serving and maintaining the database, and establish funding sources for long-term availability of the data.
- Establish governing entity for the database to decide on access levels for different data sets.
- Build pilot database server site(s) and populate it (them) with data sets as they become available. Provide an initial array of "out of the box" search/display tools.

Phase II. Full implementation (12-18 months)

- Complete conversion of entire data set and post it to the permanent servers. Enhance the available attribute data and documentation of the spatial information to the extent possible.
- Develop procedures and policies to manage database updates and long-term maintenance. Work with DUSEL personnel to identify and acquire supplemental data as they become available from researchers.
- Develop advanced search/display tools that require customized programming.
- Continue working with users to identify additional data and tools that will add value to the database.

Collaborators

Initially three groups will be cooperating in this enterprise. Each one brings unique and necessary expertise to the problem at hand. Additional consultants and advisors to the project will be sought as work proceeds.

South Dakota School of Mines and Technology

SDSMT will focus on the issues surrounding the 3D spatial data. They will take primary responsibility for the evaluation of the spatial data, the conversion from Vulcan to ArcGIS, geologic interpretation of the data, and the design of the distributed database system. Key personnel have expertise in GIS, Vulcan, 3D visualization, geology of Homestake and the Black Hills, and database systems. SDSMT currently has licenses for Vulcan, ArcGIS, and all the network GIS server software required for the project. It also as a large-format scanner that could be used to scan the physical data.

South Dakota Geological Survey

The SDGS has many years experience hosting spatial datasets and GIS information. They already serve a variety of 2D data products from their site http://www.sdgs.usd.edu/ as well as a searchable statewide core inventory database. They have a particular interest and stake in the core database and core itself. They will take an advisory role in designing the database and management plans for the project, and could potentially serve as a server site for the final database.

Homestake-Adams Research Center

In May 2005, the Homestake Mining Company of California donated to Deadwood's Adams Museum & House (AM&H) all of company's records. In partnership with the City of Deadwood, the AM&H is in the process of establishing a research center in Deadwood to house the Homestake and the Adams archival collections. The City recently purchased an existing 17,000 sq. ft. building. Construction to renovate the building will begin in 2006 with the goal of opening the facility to the public in late 2007. The primary goal of the research center is to protect the collections while making them accessible to the public.

The AM&H is in the process of hiring a consultant to develop a strategic plan which will address archival management, collections care, and accessibility issues. In addition, the AM&H plans to hire an archivist and two assistant archivists in early 2006 to assess, prioritize and process the collection; prepare it to move to the HARC; and create a database so that the materials are digitally available.

The SDSMT and HARC will coordinate efforts to ensure that the physical documents are linked spatially to the database whenever possible; and to assist each other in prioritizing the documents for scanning and digital availability. Because of what will ultimately be high visibility, the HARC is the most logical server site to host the scanned documents.

Impacts

The final database will serve many functions to a wide array of users.

- DUSEL engineers and managers will have enhanced access to critical data needed to develop and maintain the underground laboratory. Sensitive information will be protected. Long-term centralized management of the data will be ensured.
- Potential DUSEL research proposers can readily obtain the information needed to design research projects using the lab. Resulting funding proposals will be stronger with better chance of success. Easy access to the data will encourage more scientists to explore the possibilities at Homestake-DUSEL and become potential users of the site.
- Educators and researchers will have an extraordinary opportunity to access and study a comprehensive set of data for a classic type ore deposit and the historical records related to its exploitation. The educational value of this database to geologists, mining engineers, hydrologists, historians, and others cannot be overestimated.
- Outreach and public education efforts will be enhanced by easier access to customized maps, visualizations, animations, and other benefits of the database. Outreach coordinators will be better able to develop materials for public distribution, and the public portion of the database site can serve to generate interest in Homestake-DUSEL and educate visitors about its activities.

Infrastructure Requirements

This project requires no access to the underground portion of DUSEL. Should all or a portion of the digital database be permanently located at the DUSEL site, than a suitable computer server facility and office space for personnel will be required above ground.

Readiness for Deployment (Technology)

The software and server systems necessary to complete the project are readily available with current technology. Most of the hardware and software needed for Phase I currently reside between the three collaborators.

Readiness for Deployment (effort and funding)

Initial rough estimates for the personnel and resources needed to complete this project may be summarized as follows. Personnel requirements are given in total person-years to be allocated as appropriate among the collaborators as tasks are assigned.

Phase I	**cost**
Senior project managers and consultants- 2 person-years @ 80,000	$160,000
Graduate students and technicians – 8 person-years @ $20,000	$160,000
Hardware: support computers, disks and possibly a scanner for HARC?	$30,000
Indirect costs: 43% of salaries: $68,800	$68,000
Cost estimate for Phase I	**$418,000**
Phase II	
Senior database manager/programmer – 1 person per year @ $80,000	$80,000
Senior expert consultants- 0.5 person-years per year @ $80,000	$40,000
Graduate students and technicians -- 3 person-years per year @ $20,000	$60,000
Hardware costs: servers, drives	$50,000
Indirect costs: 43% of salaries	$77,400
Cost estimate for Phase II	**$307,400**
Annual maintenance for database	
Senior database manager/programmer – 1 person per year @ $80,000	$80,000
Senior expert consultants- 0.25 person-years per year @ $80,000	$20,000
Graduate students and technicians -- 2 person-years per year @ $20,000	$40,000
Hardware costs: servers, drives	$10,000
Indirect costs: 43% of salaries	$60,200
Cost estimate for annual maintenance	**$210,200**

Environment, Safety, and Health

This project requires only standard office/workplace safety measures.