To: Derek Elsworth, Larry Murdoch, T.C. Onstott, Dianna Jacobs
From: Steve Martel, Baseline Working Group Leader
Subject: Summary of Baseline Discussion of 4/21/08-4/24/08 at Lead meeting
Date: 4/29/08

Summary Points

Organization

* The Baseline Working Group sessions were presented on Monday, April 21, 2008 and Tuesday, April 22, 2008.
* The presenters at the baseline workshop were overwhelmingly consisted of microgeobiologists and biologists.
* The make-up of the baseline attendees
* The two Monday baseline sessions (Monday morning and Monday afternoon) were devoted to presentations of proposals. Owing to the large number of proposals, my desire to have all the proposals heard in full, and many of the presentations running well over their requested time allotment, there was little discussion of the proposals as part of a single collective proposal.
* The Tuesday baseline sessions (Tuesday morning and Tuesday afternoon) were devoted to discussion of baseline characterization matters, and in particular what was appropriate to characterize and what was essential to characterize.
* The Baseline Working Group never attempted to rank the proposals, many people did not present budget estimates, and we did not attempt to discuss items needed for the S4 proposals, such as Work Breakdown Structures, Project Schedules, Project Risk Analysis. The costs estimates for baseline characterization efforts typically were in the $100K – $200K/year range though.
* I did not have a clear idea on the sources of funding during the Monday and Tuesday presentations, and as a result could not present a clear picture to the working group members. Funding sources are an understandable area of concern.

Baseline Characterization Activities

* Not all the proposals fit into the mold of "experiments". Much of the baseline characterization falls into this class. Several potential baseline characterization activities would support experiments but is not necessarily a stand-alone scientific research enterprise on its own right now.
* Key baseline activities include sampling the biology; measuring the water levels and water geochemistry in the mine; sampling boreholes; characterizing the fracture systems, and measuring the radioactivity in the mine.
* The characterization efforts require coordination among the scientists and the mine personnel.
* Some potentially worthwhile experiments or other research activities cannot be well-posed at this point because the state (condition) of the biology and geology is not well known at this point; the desired data either have not been collected (mostly regarding biology) or have not been posted on the web where researchers have access to them. Without this information, several researchers can not know whether a potential research project could be expected to be viable.
* Coordinated LIDAR (laser) scanning of accessible drifts and coordinated photography would be highly desirable as a baseline activity. Fulvio Tonon (tonon@mail.utexas.edu) of UT Austin

has proposed to do this and to create a "3D Virtual DUSEL" on the web; one could move through the mine and view drift walls, biofilms, fractures, and core sample locations from different specific sites within the mine. I think scientists and engineers working on experiments at the lab, as well the general public, would very well receive this. I do not know what Fulvio projects the cost to be. He will be giving a talk or hosting a session on LIDAR and photography of tunnels at a meeting of the American Rock Mechanics Association in San Francisco at the end of June. Kevin Lesko is scheduled to give a talk as well. If Kevin has not yet met Fulvio, this meeting might be a good opportunity to do so. I only found out about Fulvio's initiative after returning from the April Lead meeting – I did not meet him at the meeting.
* Jose Alonso suggested a person might be hired for characterization but preferred that actual scientists doing sample collection become involved.
* Other key characterization matters Jose Alonso mentioned include (1) How to catalyze the BGE effort. Jose can not provide salary but can provide infrastructure and equipment funds for general use; (2) South Dakota appears to be taking a conservative approach fiscally right now, considering NSF funding to be a "bird in the bush" at this point rather than a "bird in hand". (3) The rock mechanics staff for the mine has not been assembled at this point. (4) Metals and total dissolved solids in the mine waters either are being monitored or should be monitored (my notes are unclear on this); (5) Salt was used for de-icing in the mine. This likely has contributed to corrosion of metal in the mine, and could be expected to have had a bio-geo-hydrochemical effect as well; (6) Carbon monoxide or dioxide is potentially a major problem in parts of the mine due to possible spontaneous combustion of wood in the mine.
* Mine chemicals: Various chemicals have been used in the mine (e.g., cyanide, salt, perchlorate), and the locations where these have been used would be useful to know. Some of these might be used to trace groundwater flow. The biologists are likely to be unaware of at least some of the chemicals and where they were used. Sites where key chemicals were used need to be identified.
* Biologists are concerned about the mine environment becoming non-pristine, but in many ways it already is non-pristine.
* Fracture characterization based on the existing data is likely to be highly inadequate because the fractures apparently were judged to be of little economic significance during the history of the mine.
* Kathy Hart does not have specific knowledge of major through going fracture systems in the mine. If that in fact turns out to be the case, then individual fractures in the fracture systems might be small.
* The presence of high local influxes of water into the mine suggests that at least one well-connected fracture system does exist, but its nature is not known.

Coordination

* Individuals from the various groups at the baseline sessions have relatively little experience interacting with each other. These groups are more aware of the needs of other groups after the meeting, but the understanding is certainly imperfect.
* Coordinating the baseline activities will be very important. Activities that would be helpful for one activity could be highly detrimental to another (e.g., cleaning the walls prior to scanning for fractures would be highly detrimental to several of the biologic baseline activities proposed). Several groups proposed biological sampling, and if sample collection were not coordinated, a considerable mount of redundant sampling might arise. In addition to undesirable overlap, there

is also the possibility of undesirable underlap in sampling. For example, we do not know what samples the various engineering groups might need or want.

Database

* A database to show the type, positions, and ages of mine workings (e.g., drifts and boreholes), the geology, and sample collection sites seems essential.
* The proposal of Maribeth Price (South Dakota School of Mines) to get information on-line was very well received. As best I recall, all participants consider the assembly of a user-friendly, expandable, and secure online database to be essential. Maribeth is largely focusing on geologic information from the VULCAN database now. As best I recall, hydrologic, radiometric, and biologic data are not part of her current database effort. Without this additional information being added to the database (as it becomes available), much of the baseline work and biologic, geologic, and hydrologic work will be stymied.
* Kathy Hart is compiling geologic data (e.g., tiled maps and cross sections) and mine workings data (e.g., drifts, ramps, drill holes) on the VULCAN database. This is a 3D database with a substantial learning curve. An enormous amount of geologic data and mine workings data exists. Kathy was a working geologist in the mine, so from that standpoint she is a very good person to be entering data into the database. She is working on this part time though, so for Kathy to compile all this data at the current rate of progress, I would imagine many months would be needed to compile the existing data.
* Much of the mine data is in the form of paper records that are unlikely to migrate to an electronic database. Researchers should be aware of this and should have access to the paper records.

Sampling

* Sampling is a baseline activity that nearly everyone at the baseline sessions deems necessary. The following would be appropriate to sample: air, water, biofilms, radioactivity, and a variety of chemicals.
* Sampling protocols need to be developed, and a screening committee should be assembled to do this. Scientists who work near the mine are clear choices to head this up, and some of them volunteered to do this. Cynthia Anderson of Black Hills State University volunteered for the biology, and Larry Stetler at South Dakota School of Mines and Technology volunteered for the hydrology.
* A local committee might be able to be trained in safety and collect samples for others.
* Samples locations need to be accurately located in the mine. In order for this to be done, the samplers need to understand the coordinate system for the mine, and have a way to locate themselves accurately.

S4 Proposal/ISE

* A decision needs to be made as to whether there should be a microgeobiology proposal as part of the S4 proposal package.
* Preparing a 15-page baseline S4 proposal or a 15-page microbiogeology S4 proposal at this point by the June 30 deadline will be a daunting task and will require guidance from the DEDC committee. Key issues to be addressed (a) the need to have characterization done before experiments are planned, (b) the unlikelihood that NSF would fund baseline characterization (except possibly in the form of a couple of SUGR grants), and (c) the large number of

microbiogeology proposals already submitted. The other working groups seem to have coalesced around 1-2 proposals each, instead of the 20-30 presented in the baseline sessions.
* For two key reasons I am not well-positioned to adequately lead a microbiogeology S4 proposal that is due on July 30: (1) My technical background is not in microgeobiology; (2) My schedule for May and June has me out of the office at meetings or on geologic fieldwork for five of the eight full weeks of this period. If a decision is made to field a proposal for a microgeobiology ISE, Sookie Bang might be a far better choice than me to lead this, but she is on sabbatical and I do not know if she would be available to assemble such a proposal. Andrea Neal and her faculty sponsor Patricia Holden might be able to do this. Cynthia Anderson is another.
* The proposals that stand out in my mind as candidates for the initial suite of experiments are the DUSEL Ultra-Deep Biological Observatory (Tom Kieft lead PI), the Mobile Underground Laboratory for Experimentation (MULE) (Susan Pfiffner lead PI), Biofuels from DUSEL Extremophiles (Sookie Bang lead PI); and the Pristine Fracture Zone Experiment (Rajesh Sani lead PI). I also suggested that a fracture exhibiting a "substantial" fluid flow might be worth monitoring since it would like reflect a well-connected fracture system and thus be able to sample dynamic changes in the water, the water chemistry, and the water-born biology from a large volume of rock around the mine; this could be most valuable as the mine is dewatered and might be better as a baseline activity than an ISE item. NOTE: These are my personal opinions based on a brief exposure to the work proposed at the meeting, and my background is not in biology, and my suggestions should be read with that in mind.
* The proposals that stand out in my mind for baseline projects are: (a) A Digital Database for the Homestake Mine (Maribeth Price, lead PI); (b) Characterization of the Precambrian Aquifer (Larry Stetler lead PI); (c) Fracture characterization at Homestake Mine (Steve Martel lead PI); (d) Geochemical signatures of biologic activity in the DUSEL environment (Mark Conrad, lead PI); (e) Baseline Characterization of the Eukaryotic Microbial Diversity in the DUSEL at Homestake (Cynthia Anderson lead PI); (f) Associations and Interactions of Microbes and Minerals at the Micro- and Nano-Scales at Homestake Mine, South Dakota (Andrea Neal, lead PI); (g) Analysis of lower invertebrates (Gaeten Bougonie PI). NOTE: These are my personal opinions based on a brief exposure to the work proposed at the meeting, and my background is not in biology, and my suggestions should be read with that in mind.
* Most of the biologists have not planned on doing in-situ experiments, but rather sampling of biofilms, mine waters, mine "soils", or timbers with analyses and culturing of the biota to be done in the lab.
* Some unconventional local terminology is used to describe geologic features in the mine. Researchers need to be aware of this terminology.
* Kathy's efforts need to be coordinated with those of Maribeth Price/
* Need to decide whether there should be a baseline proposal as part of the S4 proposal package.

Attachments

Accompanying this summary (Baseline_summary_4_29_08.doc)✓ are:

1. An Excel file (Dusel_baseline_proposals.xls) listing proposals submitted to the Baseline Working Group.✓
2. An Excel file (Dusel_baseline_people.xls) listing participants in the Baseline Working Group, their affiliations, and contact information. ✓

3 A PowerPoint file (DUSEL_session_1a.ppt) that I presented at the start of the Monday morning baseline session of 4/21/08. Note: The schedule in this presentation does not square with the presentations as given. ✓

4 The PowerPoint file (DUSEL_session_1b.ppt) that I presented on fracture characterization in the Monday afternoon session of 4/21/08. ✓

5 The PowerPoint file (Baseline_4_21_08_plenary) THAT IS NOT THE FINAL DRAFT I presented on baseline characterization in the Monday evening plenary session of 4/21/08. I think the final draft is on my labtop computer, which is at work.

6 The PowerPoint file (Baseline_monitoring_summary) that I presented to summarize the baseline characterization sessions on the Tuesday evening summary session of 4/22/08. ✓

7 A copy of the Word file (DRAFT_baseline_4_17_08.doc) that is the rough draft of the baseline white paper. This has not been modified since the meeting. ✓

* In addition to these files I have copies of the PowerPoint files presented by the speakers at the baseline sessions. I have not included these files here because the total size of the files is ~300 Mb and I cannot send a series of attachments that large through our e-mail system. I can post these on a University of Hawaii (UH) website so that you can have access to them if that is what you prefer; I have not had time yet to do this. An Excel file (Dusel_baseline_talks.xls) listing the actual talks presented in the Baseline Working Group is being prepared.

* Please let me know what more you need from me.