

Working Group: PODS – Geologic processes through Earth history
(eg. Petrogenesis, Ore Deposits, Structure, Sedimentation, tectonics and deformation, crustal fluids, ...)

Background and summary of discussions and proposed research by the PODS working group
April 21-22, 2008, in Lead, South Dakota

by
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Working Group Facilitator

Background

This working group had not met or collaborated via electronic means prior to the DUSEL Workshop in Lead on April 21-22, 2008. This working group was self initiated primarily through the efforts of faculty at the South Dakota School of Mines and Technology in Rapid City, South Dakota. The reasoning behind initiation of the group was that the enormous geoscience potential of the DUSEL project, in areas beyond the initially planned foci in geomicrobiology, seismology, and engineering geology, was largely untapped in research proposals submitted thus far under the DUSEL process.

Homestake/DUSEL is located in a geologically unique area which allows geoscientists to study petrotectonics, crustal deformation, and paleogeohydrology in 4D. The lab provides a window into the geology of the internationally recognized Black Hills region. For geoscientists aiming to understand processes, architecture and evolution of the North American continent this region is: (1) the southernmost exposure of the Trans-Hudson orogen; (2) at the conjunction of the Trans-Hudson orogen and the Central Plains orogen; (3) the easternmost uplift of the Laramide orogeny; and (4) the easternmost occurrence of post-Laramide Tertiary volcanism in North America. The importance of the Black Hills is highlighted by the fact that the region is a focal point of the proposed 'Lewis & Clark geoswath' of the USArray EarthScope initiative which is designed to understand the evolution of the North American lithosphere. The extensive underground access and core of Homestake/DUSEL provides a unique window into the geology of the Black Hills. To not utilize this window as a part of the DUSEL process would be to miss an outstanding opportunity for the geoscience community.

Working Group Participants

Active participants in the working group were as follows.

- Derric L. Iles, working group facilitator, South Dakota State Geologist
- Colin J. Paterson, Professor, Department of Geology and Geological Engineering, South Dakota School of Mines and Technology
- Michael P. Terry, Assistant Professor, Department of Geology and Geological Engineering, South Dakota School of Mines and Technology
- Maribeth H. Price, Chair and Associate Professor, Department of Geology and Geological Engineering, South Dakota School of Mines and Technology
- Nuri Uzunlar, Associate Professor, Department of Geology and Geological Engineering, South Dakota School of Mines and Technology

- Brennan Jordan, Assistant Professor, Earth Science/Physics Department, University of South Dakota
- Alvis L. Lisenbee, Professor Emeritus, South Dakota School of Mines and Technology
- Kelli A. McCormick, Senior Geologist, South Dakota Geological Survey

In addition to the Working Group participants listed above, there are more than 20 other geoscientists who have participated in submitting Letters of Interest on topics relevant to the PODS Working Group since February 2006. Many of the research interests represented by these scientists are aligned with the research proposed by the Working Group. We will actively seek their collaboration as the planning for underground science continues.

Summary of discussions and proposed research

The group developed a general theme that has significance beyond the Homestake mine and which addresses the gap in geologic research proposals submitted thus far in the DUSEL process. The theme, three general topics of scientific research, and specific research tasks are as follows.

Theme: Homestake/DUSEL: A window into crustal evolution from basin development through orogenesis

- 1) Crustal deformation and rheology
 - a) 4-D characterization of structures and fabrics in the Homestake mine.
 - b) Lithologic mapping of Proterozoic strata as an aid to defining structures.
 - c) Determine the evolution of overprinted structural fabrics.
 - d) Compare to kinematic models of transpression and collision.
 - e) Correlate deformation to metamorphic conditions.
 - f) Determine chronology of structural and metamorphic events.
 - g) Determine Tertiary magma emplacement mechanisms and history
- 2) Petrotectonics of the Homestake basin
 - a) Characterize the trace element and isotope geochemistry of the metabasalt (Yates unit) to identify the tectonic setting.
 - b) Determine the chemistry of the sedimentary succession/sequence.
 - c) Characterize the depositional environment of the sedimentary sequence.
- 3) Paleogeohydrology
 - a) Characterize the geometry and chronology of flowpaths.
 - b) Characterize the fluids and their role in element mobilization.
 - c) Characterize the mineralogy and chemistry of iron formation, and element partitioning across the garnet isograd.

Most of the time spent by the Working Group was devoted to the development of the above scientific research topics and research tasks. Little time remained to address the schedule. The schedule that was developed is as follows.

1. Propose theme session at a national conference (AGU) to identify further collaborators (Dec. 2008).
2. Use 3D database and document/core archives to plan sites for underground research tasks (Oct. – Dec. 2008).
3. Acquire 40-hour safety training for personnel.
4. Conduct underground visits to verify site selection, and conduct sampling for preliminary data collection and analyses (Oct. 2008 – Feb. 2009).
5. Conduct grant writing workshop for collaborators in Rapid City (Jan. 2009), including a visit to SUSEL/DUSEL facility and core archive.
6. Submit S-5 proposal by May 2009.

Facility needs were discussed as they related to space, access, power, equipment, communications, services, special materials, etc. required to successfully conduct experiments. Such needs identified were:

- Office space with internet access at the surface (not underground).
- Access to internet-accessible 3D database.
- Access to core archive, including archiving space for newly collected samples.
- Access to document archive (maps, cross sections, logs).
- Rock sample preparation and examination laboratory, including rock saw, thin section preparation.
- Access to drilling rig (underground).
- Portable coring machine.
- Roaming access to critical areas of the mine as prioritized through ongoing research.
- Robotic imaging and sampling tools.
- Onsite 3D visualization and analysis computer laboratory.

Presently, a 3D database of mine related information is not readily available to researchers wishing to plan and conduct research. Additionally, a functioning core archive and core-examination laboratory is likewise not yet available. The consensus of the Working Group is that it is extremely important that both of these “facility/infrastructure” components are available as soon as possible. In fact, the research action items developed by the Working Group are based on the premise that these two facility/infrastructure components of the Sanford Laboratory at Homestake will be available very soon.

There are no research proposals related to the topics developed by the PODS Working Group which have been submitted yet. The onus of responsibility to do so is on those who participated in the DUSEL Workshop and is on other geoscientists with similar interests. It was the consensus of the Working Group that the scientific research topics and research tasks identified at the Workshop do, however, fill a significant gap in the topics of proposed research for the geosciences. It is hoped that research of this type will be an important addition to the overall science plan for the SUSEL/DUSEL Laboratory at Homestake.