DOE Workshop Grant

(The categories below come from the NSF final grant report website. NSF funded the majority of the cost of this workshop. Looking these categories over they also seem appropriate for the purposes of DOE, so I have not rewritten or reorganized them.)

Major goals

Hold a workshop to assess the status and scientific and technical needs of the experimental rock deformation community in the USA and to organize the broader community of practitioners and users of experimental rock deformation.

Major activities

Held a 2.5 day workshop Aug 16-19, 2012 at Harvard University and a subsequent organizational meeting of DEFORM (Deformation Experimentation at the Frontier of Rock and Mineral research) on December 1-2, 2012 in San Francisco.

Significant results:

Wrote a White Paper summarizing the results of the workshop: "Advancing Experimental Rock Deformation Research: Scientific, Personnel, and Technical Needs." Created ByLaws for DEFORM, obtained founding members, and elected officers.

Opportunities for training and professional development:

Indirectly the creation of the DEFORM organization will lead to many such opportunities as described in the White Paper.

Results disseminated:

Printed copies of the White Paper have been given to interested parties.
Links to electronic copies of the White Paper have been sent to all participants of the workshop and other interested parties.

Publications:

White Paper: Advancing Experimental Rock Deformation Research: Scientific, Personnel, and Technical Needs

This is an 85 page paper describing the results of the workshop and the establishment of DEFORM. It has an abstract, an executive summary, and two appendices. The pdf version is 11.6 MB in size. I attempted to upload both it and this brief final report. However, I was unable to upload two documents and this report seemed the better of the two, due to its much shorter length. However, the detailed whitepaper may also be of interest and an electronic copy of it is available at:
https://brownbox.brown.edu/download.php?hash=0b854d11

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Impact on Principal Discipline:
This workshop, White Paper, and creation of DEFORM organization have revitalized the field of experimental rock deformation in the USA. It has led to the submission of a lager proposal to the NSF EAR IF program that is envisioned to support the many planned activities of DEFORM.

Other disciplines:
The broader communities of those that perform experimental rock deformation experiments and those that use the results of such experiments in their research have all been brought together at the workshop and within DEFORM. This will lead to tighter integration among all of these disciplines.

Human resources:
DEFORM will provide opportunities for scientists at all stages of their career to interact more productively with their colleagues across many disciplines.

Physical resources that form infrastructure:
DEFORM will open up laboratories to many more users than would have been possible without it and will promote the development of new instrumentation in many laboratories.

Information resources:
DEFORM will allow better sharing and archiving of data, both results from experiments and machine designs.

Technology transfer:
The opening up of labs and easy access to data that DEFORM will promote will make it easier for academic developments to be transferred to industry. DEFORM has both not-for-profit and for-profit institutional members.

Impact on society:
The problems that the DEFORM community works on include understanding: mantle flow and ice flow, both of which are important for understanding the potential magnitudes and rates of sea level rise due to global warming; earthquakes; induced seismicity; extraction of fossil fuels; sequestration of carbon dioxide.

Terry E. Tullis contribution to project:
Lead the organization of the workshop, took the lead in writing the White Paper, organized the DEFORM organizational meeting.

Outcomes:

Experimental rock deformation explores the fundamental physics of processes that determine the mechanical behavior of earth materials. It also provides essential data in many other areas of geoscience, including structural geology, hydrology, sedimentology, seismology, earthquake source physics, geodesy, mantle geodynamics, planetary dynamics, energy resources engineering and waste repository management. Many important scientific and societally-relevant research programs require knowledge of physical processes and data that can only be provided by laboratory experiments. Knowledge and data acquired from experiments even have important implications for understanding the rate and extent of sea-level rise that will occur due to anthropogenic climate change.

In contrast to similar groups in Europe and East Asia, the experimental rock-deformation community in the US consists of a relatively small number of scientists primarily housed at a few universities. To maintain the vitality of this field, expanded opportunities for younger experimentalists are sorely needed. One difficulty faced by young experimentalists is that the specialized equipment used in rock deformation studies is typically custom-built. Early-career scientists often cannot obtain commercially the equipment they need to conduct their research, hindering their professional development. The complexity of building and maintaining unique, sophisticated equipment and its lack of commercial availability also means that it can be difficult to operate a productive, efficient experimental lab without technical support staff. Unfortunately, technical support is unavailable in many labs in the US.

A workshop for the experimental rock deformation community was held in Boston on August 16-19, 2012, following some similar but smaller preliminary meetings. It was sponsored primarily by the NSF, with additional support from the DOE, the SCEC, and in-kind support by the USGS. A white paper summarizing the active discussions at the workshop and the outcomes is available (https://brownbox.brown.edu/download.php?hash=0b854d11). Those attending included practitioners of experimental rock deformation, i.e., those who conduct laboratory experiments, as well as users of the data provided by practitioners, namely field geologists, seismologists, geodynamicists, earthquake modelers, and scientists from the oil and gas industry. A considerable fraction of those attending were early-career scientists. The discussion initially focused on identifying the most important unsolved scientific problems in all of the research areas represented by the users that experiments would help solve. This initial session was followed by wide-ranging discussions of the most critical problems faced by practitioners, particularly by early-career scientists. The discussion also focused on the need for designing and building the next generation of experimental rock deformation equipment required to meet the identified scientific challenges.

The workshop participants concluded that creation of an experimental rock deformation community organization is needed to address many of the scientific, technical, and demographic problems faced by this community. A decision was made to hold an organizational meeting of this new organization in San Francisco on December 1-2, 2012, just prior to the Fall Meeting of the AGU. The community has decided to name this new organization "Deformation Experimentation at the Frontier Of Rock and Mineral research" or DEFORM. As of May 1, 2013, 64 institutions have asked to be members of DEFORM. Its Mission Statement:

> *DEFORM exists to facilitate experimental rock deformation research that furthers our understanding of fundamental processes and properties. Support and development of communal experimental facilities that foster innovative science are our core objectives. We enable research relevant to understanding deformation in the natural environment and encourage the participation of new users from all scientific disciplines.*

The next steps include submitting one or more proposals to NSF to support the DEFORM mission. Requests are likely to include proposing ways 1) to create a summer school that would teach fundamentals of rock mechanics and experimental techniques, 2) to provide a platform for the initiation of collaborative research projects, 3) to develop community-accessible experimental facilities, 4) to provide technical personnel available to the community at large, and 5) to develop solutions for archiving and sharing data, experimental and apparatus designs, and other community resources.