

REPORT OF THE COMMITTEE OF VISITORS, EARTH SCIENCES DIVISION RESEARCH PROGRAMS, 1999-2001

INTRODUCTION

The Committee of Visitors (COV) met on 12-14 August 2002 at the NSF Headquarters in Arlington, Virginia to review the six disciplinary research programs of the Earth Sciences Division (EAR). The programs are: *Geology and Paleontology*, *Geophysics*, *Hydrologic Sciences*, *Petrology and Geochemistry*, *Tectonics*, and *Continental Dynamics*.

The 2002 COV members are: Gail Ashley, Chair (Rutgers University), M. Lee Allison (Kansas Geological Survey), Jay Bass (University of Illinois), David Freyberg (Stanford University), Peter Malin (Duke University), T. Guy Masters (Scripps Institute of Oceanography), Leigh Royden (Massachusetts Institute of Technology), Samuel Savin (Case Western Reserve University), Leonard Srnka (Exxon Mobil Upstream Research Company), and A. Wesley Ward, Jr. (U.S. Geological Survey).

The charge to the COV was to review proposal actions taken during the period 1999-2001 with regard to integrity and efficiency of the entire process and with regard to having appropriate geographic and demographic balance. The charge also included the review of the effectiveness of the programs, areas needing improvement, and recommendations for future action. Although the COV was asked to focus strongly on "past performance", the committee believes that the current status within EAR and the future outlook necessarily affect recommendations for future practices.

Information provided to the COV included tables reporting all proposal actions and grants results from the completed fiscal years (1999-2001), the 1998 COV report (COV chaired by George Hornberger) for the same programs within EAR, and the EAR response to this report. All proposal "jackets" for the spring 2001 disciplinary panels were made available for detailed review by the COV. Approximately 120 jackets were examined from the ~620 proposals handled during the spring 2001 competition. During the meeting, the COV heard presentations by Program Directors on processes used to reach decisions, on statistics and trends within programs, and on results stemming from NSF-funded work.

The COV formed subgroups (with five people per subgroup) to consider each program in detail. The subgroups were:

Geology and Paleontology (GE)

A. Wesley Ward, Jr., Chair
M. Lee Allison
Gail Ashley
David Freyberg

Geophysics (PH)

T. Guy Masters, Chair
Jay Bass
Peter Malin
Leigh Royden

Leigh Royden

Leonard Srnka

Hydrologic Sciences (HS)

David Freyberg, Chair
M. Lee Allison
Gail Ashley
Samuel Savin
A. Wesley Ward, Jr.

Petrology and Geochemistry (CH)

Jay Bass, Chair
T. Guy Masters
Samuel Savin
Leonard Srnka
A. Wesley Ward, Jr.

Tectonics (TE)

Leigh Royden, Chair
M. Lee Allison
Gail Ashley
David Freyberg
Peter Malin

Continental Dynamics (CD)

Leonard Srnka, Chair
Jay Bass
Peter Malin
T. Guy Masters
Samuel Savin

GENERAL OBSERVATIONS OF THE COV

Overall program functioning

The COV found EAR to be in excellent operating form; the science being funded is receiving international recognition and being published in high-status journals. There is a good balance among field, laboratory and theoretically-based research. The Division Director has begun taking steps to address recommendations of the 2001 NRC Report “Basic Research Opportunities in Earth Sciences”. Program Directors have good communication with the members of their communities through workshops, professional societies, site visits, and the proposal reviewing process. The proposal solicitation, review, and funding process is balanced and fair, although some highly ranked proposals cannot be funded because of budget limitations. Other proposals are funded at lower than requested levels so that investigators return more frequently to NSF placing a greater burden on the program Officers and the “review community”.

The consensus of the COV is that it is crucial to continue to build strong individual investigator-driven research programs, while at the same time developing multidisciplinary and interdisciplinary research initiatives. The new Geobiology Program has great potential for creating cross-divisional links with ATM and OCE and cross directorate links with Biosciences. These advances will require the adoption of a division-wide policy on how to conduct fair and just reviews of proposed interdisciplinary and multidisciplinary research.

Division-wide issues

Workload- Excessive workload in EAR remains a concern. The average load in the GEO Directorate is 62 proposals per program director. Five of the six programs in EAR exceed the average, three out of six programs handle more than >100 proposals per P.O., and one

program has more than twice the Directorate average. High workloads eventually affect the ability of program officers to spend the time necessary for careful evaluation of each proposal and for providing adequate feedback to the P.I.s. High workloads are likely to result in high dwell times, hinder the competition for Foundation-wide funds, as well as limit the time for networking with their respective communities regarding new ideas and tools, encouraging diversity, and exploring future research directions, etc.

Staff -The staff situation has stabilized somewhat since the last COV, with two Program Directors now in GE, HS and TE. Staff stability is key to meeting NSF goals. There is still need of improvement, however. Note the workload issue above.

Nearly all Program Officers have proposal review responsibilities that are related to cross-division, cross-directorate and occasionally cross-foundation programs that are part of their workload, but were not evaluated by this COV. It appears that we were not asked to look at the entire spectrum of responsibilities of the EAR programs and thus could not fully answer GPRA questions concerning whether they are meeting program-specific goals and objectives.

Success rate -The proposal success rate among the 6 disciplinary programs in the interval 1998-2001 ranged from 27% to 44%; some programs were consistently low, whereas others were consistently high. Division-level changes in organization or budget are needed to reduce the inequity in success rate among the 6 core programs.

Jacket documentation -Documentation of funding actions has improved since the previous COV review, but a few programs still provide minimal information on why a certain decision was made. This information is particularly important for proposals for which mail reviews, the panel review, and/or PD recommendation showed discrepancies. All programs would profit by sharing and discussing successful approaches to getting the job done efficiently (see recommendation for a “Best Practices Retreat” below). The COV thought that Hydrologic Sciences, Petrology and Geochemistry, and Geophysics should be commended for excellent documentation of funding actions.

PI feedback - The thoroughness of written feedback to PIs varies among programs from just adequate to excellent. Some of the insufficient communications can be attributed to weak panel summaries, excessive program officer workload, and/or poor return of *ad hoc* mail reviews. One solution might be to assign individual panel members to come to the meeting with a draft of “panel summary” that could be modified after the discussion. Hydrologic Sciences and Petrology and Geochemistry were noted to have exceptionally thorough communications to their PIs, particularly to declines. However, in some cases PIs of declined proposals got mixed signals. It is common for the panel reviews to carry more weight in the final award decision than the mail reviews. Yet the PI gets the mail reviews, which might be quite laudatory, but only the written form of the panel discussion and decision. This lack of detailed communication between the program and the PI leads to perceptions that other forces are at work and can undermine the credibility of the whole decision process.

Review of Interdisciplinary proposals – Despite strong divisional and directorate statements in support, interdisciplinary research appears to be treated in an *ad hoc* basis within EAR. With the continued increase in interdisciplinary research proposals anticipated in the coming years, a division-wide management policy should be developed to conduct fair and just reviews of interdisciplinary proposals within the current disciplinary-based organizational structure.

Communication among PDs – The amount and content of communications between and among the PDs appear to be generally good, particularly with programs that are cross funded. However, there is room for improvement. See recommendation below for sharing best practices.

Program Outcomes

EAR awards are leading to discoveries at and across frontiers of science. Funding from the Division is supporting advances of major scientific or engineering importance from the Earth's core to its surface to planetary bodies and extra-solar particles. However, the 2002 COV reiterates the comment of the 1998 COV...that EAR should devote increased attention to documenting the success of its programs and that all PDs communicate the excitement of advances in the earth sciences at every opportunity.

A few examples of outcomes from the 6 EAR programs are summarized below. This list provides a sampling of the exciting research emanating from EAR awards.

There have been many observational and theoretical advances funded by Geophysics during the last few years that have revised our understanding of the Earth's core and the core-mantle boundary (CMB). The discovery by Meghan Miller and colleagues of a repeated pattern “slow earthquakes” and may provide important insights into earthquake source mechanisms and lead to better understanding of earthquake cycles in heavily populated regions..

Studies of zircons and associated igneous minerals by John Valley and colleagues have expanded our understanding of the origin and evolution of the Earth's crust. Studies of the Archean (4.0 to 4.4 GA) zircons provide evidence of the earliest conditions on Earth. Also connected to this research and funded by Petrology and Geochemistry, is the testing the recent hypothesis of a “cool early Earth” which has implications for the timing of the first oceans and origin of life.

The development of geodetic techniques based on the application of data from Global Positioning System (GPS) and interferometric synthetic aperture radar (InSAR) satellites are being used to quantify contemporary plate tectonics on a variety of time scales. Specifically, the data help constrain models of global plate motions, the dynamics of continental deformation, and earthquake hazard assessment (all funded by Tectonics).

The Hawaii Scientific Drilling Program (funded through Continental Dynamics) confirmed the radial structure of the Hawaii mantle plume and major short-term

(thousands of years) variations in the lava character were documented with geochemistry and isotope ratios. An unanticipated bonus from the drilling program was the discovery of microbes up to 1.6 km depth and fresh water to 2 km. These findings radical change local hydrologic models and our understanding of the physical boundaries of the biosphere.

New fossil finds in Pakistan led to some startling finds on the evolution of whales (funded by Geology and Paleontology). Documentation of the early evolutionary development of small semicircular canals, the organ responsible for balance in inner ear of cetaceans, that allowed them to be highly acrobatic swimmers without becoming dizzy. The researchers found that whales acquired this special trait quickly and early on in their evolution. This was a defining event that likely resulted in their total independence of life on land.

Dr. Jillian Banfield's (U.C. Berkeley) paper on "How molecular-scale interactions underpin biogeochemical systems" reflects the commitment of NSF/EAR to fostering fundamental research that may require years for the complete impact to become manifest.

Awards from Hydrologic Sciences have led to our ability to better characterize the heterogeneous nature of groundwater flow patterns and the fate of contaminants in densely populated areas. Advances are also being made in the discerning of human influences on hydrologic extremes (floods and droughts).

Recommendations

Increase staff -The COV recommends that efforts be made to reduce workload by increasing the number of program officers and staff in EAR.

Review and share best practices- There is unevenness in the effectiveness of management of the 6 disciplinary programs; all have strengths and all have some weaknesses. It is the consensus of the COV that EAR as a whole would benefit from an occasional (yearly?) retreat at which the Division Director, Section Heads, program officers and staff could share best practices. For example, how does one get a detailed thoughtful panel summary to document the decision and to pass it on to the P.I.? How can the ad hoc mail return rate be improved? Are professional society meetings the best way to network with the community? Fresh PhDs and post-docs are a valuable resource; how can they brought into the review process early? Petrology and Geochemistry has developed an exemplary spreadsheet (also commented on by the 1998 COV) that could serve as a model for other programs to adopt.

Look into more co-operative research with industry- The COV suggests that it would be fruitful for EAR to re-examine its philosophy and mechanisms in place for facilitating cooperative research by PIs with industry. This suggestion is driven by a number of factors, including: 1) the large number of technical areas in which EAR programs share common ground with activities in industry, 2) the very large amounts of industry geoscience data and basic research, 3) the guidance that is often given to PIs by EAR

program panels to coordinate better with industry in their research projects, and 4) the movement within several large petroleum companies to increase their research leveraging with the academic community. With the possible exception of drilling issues handled through DOSSEC, in most cases PIs essentially fend for themselves to scope industry resources, identify staff contacts, build relationships, and finally gain access to industry resources. This can be an arduous process that requires considerable pre-investment of time and money prior to research funding. Similar (and different) problems occur on the industry side. Thus it may be beneficial to consider initiating an EAR effort that would facilitate such activities by potential and existing PIs, thereby benefiting both EAR basic research and industry activities. This EAR industry interface activity should be administered at the Division level, and could easily become a full-time activity for one senior EAR staff officer. A similar NSF-wide initiative could also be considered. Close coordination with similar activities in the American Geological Institute is advisable.

Comments for future COVs The written documentation provided to the committee was uneven with respect to completeness of information provided. A high quality spreadsheet of proposal actions and a more consistent way of highlighting program results should be adopted by the entire Division

REPORTS FOR INDIVIDUAL PROGRAMS

GEOLOGY AND PALEONTOLOGY (GE)

Proposal Processing

The Geology and Paleontology Program (GE) considers proposals in geomorphology, sedimentology, stratigraphy, low-temperature geochemistry, paleontology, and the biogeosciences in general. The program receives proposals that reflect a wide range of space and time scales (including deep time) and are often co-funded by other NSF programs responsible for atmospheric, ocean, hydrologic, biologic, solid earth, polar, and anthropologic sciences. This exceptionally wide scientific scope results in large number of proposals. As noted by the previous COV, this program has the highest number of proposals submitted to any EAR program, an average of ~255/year (1999-2001). The success rate for that period was 27%. The GE Program now has two PDs (Lane and Barrera) and one staff assistant (Smith-Mitchell). This represents an improvement in the management of the program since the time of the last COV review -- the years 1997 – 1999 involved approximately 270 proposals annually, managed by a single PD. Despite the proposal pressure, the core GE budget has not increased over the last 13 years. The 2002 GE subgroup selected 18 proposals from the spring 2001 panel meeting for detailed consideration. The proposals included a range of rankings from awards to declines, with the bulk laying in the “gray” zone.

External Reviews

Mail reviews are solicited from several outside reviewers. A minimum of three reviews are required for a decision; five reviews are preferred. All mail reviews are made available to the semi-annual reviewing panel, prior to the meeting if the reviews are received in time. Otherwise the mail reviews are made available at the panel meeting. The panel consists of ten members reflecting the broad scientific scope of the program. A "primary" and two "secondary" reviewers are assigned for each proposal, so three panelists read a given proposal in detail. At the panel meeting, the primary reviewer leads the discussion.

The *ad hoc* mail reviews often are uneven, even though there seem to be several qualified reviewers for each proposal. We discovered what might be interpreted as inflated or “fluffy” reviews in a number of cases; in particular, one mail-in reviewer gave a proposal a rating of “Very Good” (score = 4), yet provided only seven sentences of documentation or support for the entire review.

This discrepancy was nearly always overcome by thorough and detailed discussion by the panel. It is especially important that mail-in reviews get to at least the primary and secondary panel reviewers for each proposal prior to the panel meeting so that such

outside reviews can be researched for thoroughness and accuracy and placed in the proper context at the time of panel discussions.

We also recommend that panels discuss (and the Program Officer document) either mail-in or on-site reviews whose recommendations lie significantly outside the cluster of other reviews; e.g., single reviews that are lower or higher may reflect conscious or unconscious bias, or indeed may reflect insight that needs to be conveyed, understood, and incorporated.

We encourage the Program Officers to continue to provide the mail reviews to the panel members as early as possible and to encourage the panel to make use of these reviews. The mail reviews represent a huge effort by the community, and can be extremely useful. We would further encourage Program Managers to take note and not continue to use mail-in reviewers whose reports are considered to be cursory (whether supportive or not)

Decision Documentation

Decisions were adequately documented, for example -- the Form 7 filled out by the Program Director. In some cases, however, Program Directors funded proposals evaluated by the panel as only marginally “good” to “very good”; often such proposals are funded instead of others that were ranked somewhat higher by the panels. Although the COV recognizes the prerogative of the PD to do so, notes or documentation from the manager as to overriding considerations in such cases are none-the-less necessary. The same is true for proposals that are rated relatively highly by the panel, yet are denied funding by the program; documentation and statements as to denial on the basis of program balance, etc. are needed.

In the case of jointly submitted proposals, paperwork in each jacket needs to match exactly (except for the original proposal) so that separate investigators do not get different reports or answers to inquiries to the Program Director(s).

Feedback to PIs

Feedback to the PIs may well be hampered by the heavy workload of the Program Directors. Mail reviews are provided, but often little else. It is valuable to PIs to have more than the mail reviews as feedback. Mail reviews can be confusing if there are contradictory recommendations. It would be extremely valuable, particularly to young investigators (e.g. CAREER applicants) to know the major flaws the Program Director found that led to declination of the proposal. This feedback need not be more than a paragraph but it must be specific.

Some rejection letters to PIs of poorly rated proposals, especially those citing only a shortage of Foundation funds for lack of support, may actually encourage resubmission. It is important that the Director’s summary and rejection letter to the PI accurately reflect the scientific reviews of the panels with regard to the weaknesses and corrective measures necessary for rejected proposals.

Balance

The GE program is supporting a balanced program of field, laboratory and experimental studies focused on surficial-terrestrial research; a considerable proportion is interdisciplinary in nature. The funded PIs include a healthy mix of senior to early career scientists. The program continues to have respectable numbers of new PI's, women, minority, and undergraduate institutions funded from the new proposals.

GE is supporting one of the first EAR Centers (National Center for Earth Surface Dynamics, University of Minnesota). GE cooperates in Geoscience Directorate-wide activities such as the Carbon Cycle, the Water Cycle and Biogeosciences. Foundation-wide activities handled by GE include LExEn and Tree of Life. The GE subgroup did not look at any proposals from these Directorate- or Foundation-wide activities.

Overall Technical Management

The overall technical management of GE is excellent. The program staff is to be commended for handling such a large number of highly disparate research topics so well. It appears from the data presented to us that their workload (measured by the total number of proposals) is quite large. This workload has the potential of impacting the quality of the program by (1) reducing the amount of time the PDs can spend with PIs, (2) limiting the Directors' time to network in the GE community, and (3) restricting their ability to compete for funding from Foundation-wide Initiatives. The COV recommends that a solution be worked out to alleviate the workload inequity. Possible alternatives are: add more staff assistance (such as a third program director, i.e. rotational PD) for the program, or reduce the number of subdisciplines this program supports; e.g., moving low-temp geochemistry into geochemistry?

It is not clear how truly interdisciplinary proposals can be evaluated – do certain “interdisciplinary” panels need be created, or is a system of co-evaluation, or dual evaluation, workable? The current system relies on personal relations among Program Officers. The need for appropriate reviewing procedures for interdisciplinary proposals is likely to increase in the future and a division-wide protocol should be established.

Program Content (Quality/Results)

Program leadership is proactive and visionary; they have held nearly a dozen workshops in the last few years to solicit information and present overviews on the future directions of EAR in the subdisciplines of stratigraphy, low-temperature geochemistry, paleontology/paleobiology, and sedimentology/geomorphology. They have participated in a number of Town Hall Meetings at GSA, AGU and AAPG/SEPM. Twenty-five journal articles supported by this program have been published in the prestigious journals Science and Nature since 1998. Several discoveries that captured widespread public attention through the media were funded through GE: discovery of live Permian microorganisms, determining the relationship between evolution and mass extinctions, and important insights into evolution of whales. Although the core budget has remained

essentially flat, exciting, new programs, such as LExEn, and the new EAR Center, National Center for Earth Surface Dynamics has recently been added to the mission of this Program.

GEOPHYSICS (PH)

Proposal Processing

There have been several changes in the way proposals are processed in Geophysics since the last COV. A major change is that proposals in Experimental and Theoretical Geophysics (ETG) are now considered together with proposals from Seismology (S) with a single budget. Previously to FY 2002, the proposals were considered separately as two mini-programs and this was the case for the Fall 2000 group of proposals considered here. COV believes that the change to considering the proposals in one group is a good one and will promote the best science being funded. Another change is that the Geophysics panel has been expanded from six to seven members with the new member typically being a junior person who serves for one panel only and is expected to benefit from exposure to the review system. COV believes that further expansion of the panel may be desirable as some subdisciplines are unrepresented (see below).

The Geophysics program averaged about 220 proposals each year during the review period. The spring 2001 panel actions that were reviewed closely, involved 74 Seismology and 45 Experimental and Theoretical Geophysics (ETG) proposals. This imbalance of proposals in the two sections appears to be unusual and led to atypical success rates. Overall, there was about a 44% success rate by number of proposals funded and about a 35% success rate by funds awarded to funds requested. The average annual award by proposal was about \$67K with an average award duration of 2.4 years.

The Geophysics subgroup of the COV selected 27 proposals from the ETG and Seismology subprograms for detailed consideration. They also considered summary evaluation sheets for all of the Fall 2000 proposals.

External Reviews

Six to ten mail reviews are solicited for each proposal with most proposals receiving four to five reviews. This relatively poor return is unfortunate, but it is average for EAR and it is not clear how this can be improved. With the advent of Fastlane, reviews are available to panelists as soon as they are entered into the system. Panelists are requested to read all of Geophysics proposals. In fall 2000, primary and secondary discussion leaders were assigned in advance of the panel meeting. The primary reviewer lead the discussion of the proposal while the secondary reviewer was responsible for writing the panel summary. CSEDI proposals are evaluated by a separate panel.

Not all proposals are discussed by the Geophysics panel due to the sheer number of proposals. Proposals with the lowest mail-review scores are not discussed unless a panel member requests so. Proposals with the highest mail-review scores are not likely to be discussed by the panel, again unless a panel member makes a request. This procedure seems to be appropriate.

The Geophysics panel makes recommendations by placing proposals into categories of "Must fund", "Fund if possible", and "Do not fund". All "Must fund" proposals were selected for funding. All but the lowest ranked "Fund if possible" were selected for funding. It is clear that the Program Directors follow the panel recommendation in almost all cases.

In the Fall 2000 panel, a number of seismology proposals with strong mail reviews fell into the "Do not fund" category on the basis of their panel evaluations. This seemed to be particularly true for those using crustal seismology to address tectonic problems. Part of this was due to the unusually large number of seismology proposals in this particular panel and merging S and ETG may go some way to alleviating this problem. However, the COV believes the problem may be symptomatic of a lack of panel expertise in this area or it may be that such proposals are more appropriately reviewed in the Tectonics or the Continental Dynamics panels. The COV recommends that the Program Directors of the three panels consider how best to resolve this issue. We note that the appointment of David Fountain as permanent PD of the Tectonics program may go a long way to solving this problem. The PD indicated that she is aware of this issue and that PH and TE have agreed to co-review proposals, where appropriate. This is clearly a step in the right direction. Apart from this generic issue, COV found the ranking of proposals to be fair and impartial.

Decision Documentation

The COV found the documentation of both Seismology and ETG proposal decisions to be very thorough and commend the program officers on their efforts. Both PDs interacted strongly with PIs by email and were particularly helpful to those with proposals just below the funding line. In addition, all PIs get copies of all mail reviews and the panel summary.

As noted by the previous COV, one area that should be improved in the documentation stream is the panel summary comments. The panel summaries reviewed were often very terse. Additional analysis could be provided to convey the basis for relative rankings. Given the adherence to panel rankings, improved documentation is required -- particularly in those cases where panel ranking and mail ranking are very different. One change that might improve things is the use of the "Interactive Panel System" which facilitates writing and review of summaries at panel. This was used in the 2002 panel though we have not seen examples of the new summaries. Another change, suggested by the PD, is to extend the panel meeting by another day to give more time to formulate summaries. COV strongly endorses this idea. It is also our impression that panel summaries in some other core programs are better than those in Geophysics. Some other

programs require the lead reviewer to produce a "first draft" of the panel summary before the meeting which we believe would promote more thoughtful and thorough panel summaries.

Feedback to PIs

The feedback on both ETG proposals and Seismology proposals is extensive though somewhat limited by the quality of the panel summaries. Both PDs interacted strongly with PIs by email and were particularly helpful to those with proposals just below the funding line. In addition, all PIs get copies of all mail reviews and the panel summary.

Balance

The Geophysics program has moved toward somewhat longer project duration, and this appears to have had a positive impact on success rates. In the case of established PIs with a history of extremely strong proposals, the PD has adopted the practice of extending the duration of the award. This reduces effort for NSF, the community, and the PI and seems to the COV to be appropriate. The PD has also encouraged some PIs who typically submit multiple proposals to panel to condense their proposals into one. This practice reduces workload and makes assessment easier – it also tends to increase success rates. A broad selection of senior and junior researchers is represented among the funded projects and the distribution of institutions also is broad. The Geophysics program did not fund any CAREER proposals during the period 1999-2002. However, a number of REU and RIU awards were made during this period. The range of funded PIs fairly represents the applicant community. However, we did not have the data to assess whether, or not, the range of PIs funded represents the *potential* applicant community.

The Geophysics panel handles proposals spanning seismology, geodesy, geodynamics, geomagnetics, mineral physics, and neotectonics. It is not always possible to have a panel with six (plus a junior) members cover every aspect of these fields in depth and, as noted above, the Fall 2000 panel may have been lacking expertise in at least one major area. Perhaps it is possible to find seven people broad enough to cover all fields adequately or, more likely, an additional panel member may be necessary. Co-reviewing proposals with the Tectonics program may remedy the situation. COV endorses the idea of inviting a junior person to a single panel to expose young faculty and researchers to the review system.

Overall Technical Management

The Geophysics program appears to be functioning extremely well. Peer evaluation through mail reviews and through panel activities appears to play an appropriate role in funding prioritization.

Program Content (Quality/Results)

The Geophysics program has been extraordinarily successful in stimulating and fostering discoveries across a broad range of topics. The CSEDI initiative has provided a

mechanism for fostering multidisciplinary research in deep earth studies. There are also many examples of funded multidisciplinary projects within the Geophysics program itself. Geophysics activities involving NEHERP, Global Change, and collaborations with Russia and developing nations constitute significant service to society.

Examples of excellent results for fostering creative science abound. In the past three years, interest in Earth's core and the core-mantle boundary (CMB) has been intense and has resulted in many observational and theoretical advances. The impact of NSF-funded work in this area can be demonstrated by noting that at least 25 Nature and Science articles were published in this review period. The recent SEDI meeting in 2002 (sponsored by NSF) focused on the core and the CMB and highlighted the complexity of structure in the inner core and at the CMB, as well as advances in experimental and theoretical high-P and T work on iron and its alloys. Another major focus of research in the past three years was stimulated by the hypothesis of a deep dense compositional layer near the bottom of the mantle to explain a mixture of apparently contradictory geophysical and geochemical observations. This hypothesis remains extremely controversial and has stimulated a huge amount of research in mineral physics, seismology, and mantle dynamics.

The program also sponsors research in earthquake source mechanics. Among the "hot topics" funded by the program are earthquake triggering and transient slip events ("slow earthquakes"). A fascinating example is the discovery of a repeating pattern of slow earthquakes along the Cascadia subduction zone from the analysis of geodetic data. These curious events have been identified in several seismically active regions around the world and may be an important contribution to the slip budget. The CSEDI program has sponsored numerous exciting multidisciplinary projects that have made major contributions to understanding structure and processes near the core-mantle boundary, structure of the upper mantle transition zone, and processes associated with deep-seated earthquakes.

HYDROLOGIC SCIENCES (HS)

Proposal Processing

The Hydrologic Sciences Program (HS) received an average of 145 proposals/year for the 1999-2001 period (Table 6) with a modest base budget growth from \$6.3 million to \$6.9 million. The Program participated and co-funded in several cross-program initiatives during this period, including WEAVE (Water and Energy: Atmospheric, Vegetative, and Earth Interactions), EGB (Environmental Geochemistry and Biogeochemistry), MMIA (Methods and Models for Integrated Assessment), EPSCoR (Experimental Program to Stimulate Competitive Research), and the CAREER program. The success rate for proposals is one of the lowest in EAR, 27% over the three fiscal years considered in this review (as presented in Table 6, Tab 11 of the COV information packet), reflecting the breadth of hydrologic research, the size of the hydrologic research

community, and the nature of alternative funding sources relative to the available base budget. Dwell times for proposals improved significantly over the three-year period.

The subgroup of the COV examining the March 2001 funding round for HS read 16 jackets out of 58 proposals submitted. We chose several from the funded top of the ranked list, several from the declined bottom of the list, a number from the “gray area” at the bottom of the funded list and top of the declined list, and several that showed a significant discrepancy between average mail review and panel scores. Overall, we found that the review of proposals is thorough and fair. Documentation of decision-making is exemplary, as is communication with and feedback to PIs.

External Review

The HS PDs use ad hoc mail reviews, reviews by a 3-person subset of the panel, and an overall discussion, numeric rating, and final ranking by the panel to form and support funding decisions. The PD requests ad hoc reviews from 8 to 12 reviewers and requires a minimum of 3 completed reviews before taking the proposal to the panel. Three panel members are assigned each proposal, with one member defined as the lead reviewer with responsibility to lead the discussion at the panel meeting. The three panel reviewers receive the proposal and mail reviews prior to the meeting, with the proposal jacket, including late reviews, available to the full panel at the meeting. The panel discusses each proposal, develops a numeric rating by a vote, and then after discussing all proposals, creates a ranked list of the proposals.

For all of the jackets studied the external reviewers appeared to be an appropriate group for the proposal content. The panel reasonably represented the substantial breadth of expertise underlying the large range of proposal topics. The panel summaries are substantive and detailed, often providing explicit feedback to the proposers (both high-ranked and low-ranked). They address the mail reviews, as well as issues raised during the panel discussion.

We particularly chose to examine a number of jackets for proposals for which there was a substantial difference in the average mail review score and the average panel score, as shown on the HS summary spreadsheet. In all cases it appeared that the differences were caused by scaling differences rather than by a significant difference in the assessment of proposal quality. We did detect a tendency of the panel to trust experienced, successful investigators to overcome some problems of research design raised in either or both the ad hoc reviews and the panel discussion. While that trust seemed appropriate in the particular cases, and did not extend to fundamental flaws in research design or to all experienced investigators, it does mean that the panel and PDs must be very cautious not to place less-experienced investigators at a disadvantage. We did not find any evidence of this in the overall funding pattern, but we think that a word of caution is appropriate. It is also worth noting that it is the high quality of the panel discussion documentation that allows us to make this observation.

The funding decisions of the PDs in the funding round we examined were very consistent with the relative ranking developed by the panel. We explicitly examined a number of proposals in the “gray area” at the bottom of the funded list and top of the decline list. The decisions in this group of proposals were fair and sound (and well-documented). Because over 25% of HS funding comes from outside the HS base budget through joint funding with other programs, we looked for, but found no evidence of, funding sources leading to decisions inconsistent with the relative quality of proposals.

Decision Documentation

The documentation in the proposal jackets is superb. The decision rationale is presented clearly and thoroughly. The summaries of the mail reviews appear unbiased and the PD’s discussion of the panel review draws very directly from the panel’s summary. We found this high quality of documentation for all jackets we reviewed, whether highly-ranked and funded or low-ranked and declined.

Feedback to PIs

The documented feedback to the PIs from the HS Program was equally superb. The PD provided nearly all of the information in the decision documentation in a straightforward, respectful style. The result appears to be very thorough, thoughtful feedback to all PIs. We found this consistently across the full range of proposal quality, as well as for both first-time investigators and experienced senior investigators. We did find one case in which the PD did not appear to provide sufficient discouragement of resubmission, given the panel summary and mail reviews, but otherwise the feedback appeared consistent with the overall tenor of the panel recommendation.

Balance

Hydrologic science is very broad in its interests, as well as in its coupling with the mathematical, physical, chemical, biological, and other earth sciences. It is dependent on field data collection and experimentation, laboratory experimentation, sophisticated data analysis, as well as complex mathematical modeling. Some areas of hydrologic research, especially applied, are funded by other federal agencies, but a significant portion of the hydrologic science research community must look to HS for support. Given that broad mandate, HS appears to support an appropriate balance of research. The Program appears to be doing an excellent job of seeking out co-funding both within and without EAR so that interdisciplinary work can be supported.

The Program appears to be supporting a broad range of investigators representing the breadth of the community (small schools, large schools, undergraduate institutions, young PIs, senior PIs). The program funded women and men PIs at comparable rates. It also attracted the largest number of proposals from minorities of all the EAR programs, although the absolute numbers still remain unfortunately very small.

Program Content (Quality/Results)

The HS Program has now established a track record of supporting excellent science across a remarkably broad spectrum of hydrologic research. General areas supported include hydrometeorology; watershed hydrology; vadose-zone hydrology; groundwater hydrology; physical, chemical, and biological processes governing contaminant transport in both surface and subsurface aqueous environments; erosion, deposition, and transport of sediment and associated contaminants; earth surface dynamics; and water fluxes through the soil, vegetation, atmosphere continuum. HS-supported research has led to a significant number of publications in the major archival journals for hydrologists. The list of supported investigators includes the top scientists in the field, both established and up-and-coming. Prof. Ignacio Rodriguez-Iturbe, an HS-supported scientist from Princeton University was awarded the 2001 Stockholm Prize, by far the most prestigious and visible award available to hydrologic researchers. Two recently NSF-funded Science and Technology Centers, the National Center for Earth-Surface Dynamics (NCED) and the Center on Sustainability of Semi-Arid Hydrology and Riparian Areas (SAHRA) are led by prominent hydrologic scientists.

Because of the importance of water as a human resource and hazard, a significant fraction of HS-supported research has direct benefits to society. Recent HS-supported research has had impacts on managing contaminants in the environment, maintaining sustainable water supplies and riparian ecosystems in semi-arid environments, and predicting the impacts of climate change and land use change on water resources, for example.

The HS Program has been a leader in developing the CUAHSI (Consortium of Universities for the Advancement of Hydrologic Science, Inc.) initiative involving 60 universities with programs in hydrologic science. The hope is that this initiative will lead to greater visibility, coherence, and support for hydrologic science throughout government and society.

PETROLOGY AND GEOCHEMISTRY (CH)

The CH program handles proposals involving laboratory, field, and theoretical studies of petrology and geochemical interactions at all scales, ranging from crustal petrogenesis to the composition of the deep mantle and core, to cosmochemistry. An average of 210 proposals per year for the 1999-2001 period were evaluated by two panels; the average success rate was 43%.

The information provided by the CH Program Director to the COV committee was excellent, including a description of organizational changes made since the last COV review, staffing over time, details of the review process, descriptions of the various subject areas that look to this program for support, and highlights of key accomplishments.

Staffing of the CH program had been unsteady since the departure of Maryellen Cameron in 1997. During that period the program was staffed by a number of different rotators and temporary program directors. The hiring of Sonia Esperanca as permanent Program Director in August 1999 was a positive step that will give stability to the program. Given the proposal load of the CH program, the COV believes that two permanent program directors and one rotator are necessary.

Proposal Processing

At the time of the last COV all proposals were put into one of five categories: economic geology, mantle geochemistry, volcanology, crustal processes, or experimental, and program directors tried to achieve a degree of balance in funding these groups. This model has been dropped. All proposals now compete without regard to sub-discipline in an attempt to simply fund the best science. The COV sees this as a positive change in the program. In addition, the Environmental Geochemistry and Biogeochemistry (EGB) program was discontinued, with a transfer of funds for EGB proposals to the Geology (GE) and Hydrologic Sciences programs. The COV sees this as another positive change that allows CH to concentrate on its core scientific portfolio.

The COV examined 24 jackets for proposals submitted in December 2000 and discussed at the March 2001 panel meeting. A total of 107 proposals for 96 projects was submitted for that round. The success rate for proposals submitted in that period were about 50%, and an average award of \$150k and an average duration of 2.3 years. The COV focused mainly on the fairness of the decision process, the quality of the proposals funded, feedback to principal investigators, overall documentation of the decision-making process, and tried to identify areas in which decisions could be improved. A list with the relative ranking of the proposals was provided to the COV, with proposals divided into “Must fund”, “Fund if possible”, and “Don’t fund.” categories. Most of the proposals examined by the committee were from the “gray” or “fund if possible” category. Both successful and unsuccessful proposals in this category were chosen. The committee also examined proposals with the largest differences between the average mail scores and the panel scores, and a few proposals in the “Don’t fund” category.

External Review

About 10 external mail reviews were requested for each proposal, with 4-6 reviews being returned. Proposals were initially ranked on the basis of the mail reviewer’s evaluations. At the panel meeting a few of the proposals with the highest mail rating were accepted as in the Must Fund category if there was unanimous agreement of the panel. Most of the panel discussion involved proposals that wound up at the bottom of the Must Fund and in the Fund if Possible categories. Proposals with the lowest mail reviews were not discussed if the panel unanimously agreed with the mail ranking.

Decision Documentation

The COV found the documentation in every jacket to be uniformly outstanding. The panel summaries were highly detailed and informative. In most cases, the points raised in anomalously high or low mail reviews were explicitly addressed. Each jacket appeared to have all communication between the PI and the PD, including hand written notes on phone conversations, emails, etc.

Feedback to PIs

The formal acceptance and decline letters to the PI's were very specific about the strengths and weaknesses of the proposal, its relative ranking, and the basis upon which the final decision on funding was made. The letters provided by the Petrology and Geochemistry program are a model for all programs. The committee was highly impressed that in cases where the panel and mail evaluations differed substantially, or where one or two mail reviews gave anomalous scores, these issues were explained either in the panel summaries or in the program directors notes. It was exceptionally easy to evaluate the decision-making process for this program. More important, in the event of a negative decision the letter to the PI makes it very clear why a proposal was not successful and what needs to be improved.

Balance

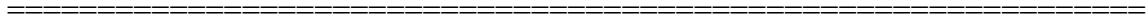
The funding rate for women in this program are about the same as for the division overall. The summary sheets for the round of proposals examined by the COV indicated whether a PI is either a woman, an ethnic minority, or is a new investigator. The PD explained that she consciously tries to take these factors into account when making a final funding recommendation. Based upon the data available to the COV, it seemed that such balance was achieved without sacrificing the quality of science funded by this program. The COV appreciated the frankness and openness of the PD in describing how she balances numerous competing factors in arriving at her decisions. An attempt is also made to obtain representation by EPSCoR and undergraduate (RUI) institutions in positive funding decisions.

Overall Technical Management

The workload in this program is high, as with many other programs in Earth Sciences. The new PD has done an outstanding job of handling this workload with a high degree of professionalism and fairness. Optimally, it would be best to have another permanent program director for this program, as well as a rotator. An increasing number of demands are being made on PD's due to participation in new programs (e.g., ITR, Math), and these may ultimately wind up compromising the job done in individual core science programs like CH. The evaluation of the COV is that the management of this program is excellent, but will be difficult to maintain without additional staff.

Program Content (Quality/Results)

This program is funding high quality fundamental research. An impressive number of articles in highest quality journals (e.g., Science, Nature, Earth and Planetary Science Letters) have come from funding in Petrology and Geochemistry. Within the 1999-2001 period, proposals funded resulted in a series of papers that bridge astrophysics and planetary/earth sciences. Also awarded were a number of studies of mineral structures and synthetic compounds using new analytical methodologies such as NMR, raman spectroscopy, synchrotron x-ray diffraction and TEM, etc. CH has funded the development of some innovative techniques for petrological analyses, such as the use of the X-Ray tomography to map metamorphic and igneous textures. These maps can be applied to a variety of fundamental petrologic questions. In situations where there is scientific overlap between proposals submitted to CH and areas handled by other programs, the PD has done a good job of obtaining joint funding from other programs for specific projects. Joint funding has been primarily with the Geophysics programs. This is a sensible practice and one that we hope will be continued and extended to include other programs.



TECTONICS (TE)

The mission of the Tectonics Program is to fund research aimed at understanding stresses and forces of the Earth's lithosphere. This includes studies of active deformation and investigations of older orogens. In contrast to many of the other basic disciplinary panels (e.g. Geophysics, Petrology and Geochemistry), the purview of the Tectonics program is defined by process rather than by the specific disciplinary tools used to carry out the study. Thus the program invites proposals in a wide variety of disciplines including geodesy, geomorphology, structural geology, metamorphic petrology, igneous petrology, stratigraphy and sedimentology, geochronology, isotope geochemistry and thermochronology.

Review of the Tectonics Program by the 2002 COV occurs at a time of major transition, with the retirement of the long-term PD occurring in October 2001 and appointment of a new permanent PD in September 2002. Significant changes in the proposal evaluation process have been instituted since the departure of the former PD. The comments below thus reflect the functioning of the Tectonics Program under the direction of the former PD as well as more recent changes to the program instituted by the acting PD.

Proposal Processing

The Tectonics Program received approximately 176 proposals per year for the period 1999-2001 (Table 6), with a funding rate of 35%. The COV subgroup that evaluated the March 2001 TE jackets read approximately 20 proposals out of approximately 100 submitted. Of these, 5 were from the group of funded proposals reviewed by mail and panel, 3 were funded proposals with PIs concurrently sitting on the Tectonics panel and not subject to panel review, 2 were unfunded proposals that ranked near the bottom by mail and panel review, and the remainder were selected from highly ranked, but unfunded, proposals. Of the latter, particular attention was given to proposals for which mail reviews, panel review and/or PD recommendations showed significant discrepancies.

External Reviews

Proposals are sent to approximately 6-8 external reviewers, with approximately 3-6 external reviews returned for each proposal. Average mail reviews for 1999-2001 period was 4.7. Choice of reviewers is generally well thought out for each proposal, with reviewers being knowledgeable and experienced in the relevant disciplines. Most of the external reviews were thoughtful and offered comments both on the larger importance and the technical details of the work. Choice of external reviewers and the quality of the external reviews are a strong point in the Tectonics review process.

Prior to the last COV visitation in 1998, mail reviews were not shared with the panel except for excerpts chosen by the PD, and mail and panel reviews were handled separately and coordinated by the PD. By the time of the spring 2001 panel meeting this procedure had changed and the entire panel read mail reviews. However, the COV subgroup that read the Tectonics jackets found several instances where the mail reviews were effectively ignored by the panel and large discrepancies in ranking from external evaluations and panel evaluation were not discussed in the panel summary. This was especially troublesome in cases where the panel did not contain the necessary expertise to evaluate the technical details or overall merit of the proposed study. Of greater concern was the disregard of the PD for the external reviews in making funding decisions for the large number of proposals that fell into the gray zone. This is not only a matter of incomplete documentation, but also misstatements in the PD summary concerning the thoroughness, scope and/or enthusiasm of the external reviews. This is discussed further under the section on decision documentation.

As of March 2001, meshing of the external and panel review processes has been streamlined, with panel members receiving mail reviews of all proposals (except for those COIs, conflicts of interest) well before the meeting, via Fastlane. This is an important step in that it not only allows for early and thorough perusal of mail reviews by the panel, but also for interactive panel summaries of proposals produced at the panel meeting.

As an additional comment, it is the practice of many of the EAR programs to bypass the panel review process for PIs who sit on the program panel, and to evaluate these

proposals by mail review only. In the batch of proposals reviewed by the COV for Tectonics, some of these proposals were evaluated, and funded, on the basis of only 3 mail reviews returned out of 6-7 reviews solicited. This does not constitute an adequate review. It is important that more reviews be solicited for such proposals in order to ensure the PIs of all proposals a fair and balanced review process.

Decision Documentation

The 1998 COV found the decision documentation by the PD to be inadequate and recommended major changes in this area. The situation has improved since that time. For the March 2001 proposals, spreadsheets that summarized proposal rankings and outcomes were available and easily inspected. It was especially helpful that two lists were produced, one rank-ordered by panel evaluation and one rank-ordered by mail review. This made it particularly easy to spot outliers in the funding pattern or cases where particular attention needs to be paid in justifying decisions to fund or not fund, and in reconciling large differences in ranking via panel and mail review. We encourage the current PD to continue to improve documentation by including additional information on the spreadsheets – excellent prototypes exist in several of the other EAR programs.

Of the proposal jackets read by the Tectonics subgroup of the COV, there was a huge difference in the decision documentation (Form 7) by the longstanding PD and by the temporary PD, Dave Fountain. This is of note especially since Dave Fountain will be the permanent PD for Tectonics as of September 2002. Decision documentation by the former PD was inadequate, at least for proposals in the gray funding area, and consisted of only a few sentences, often not dealing substantively with the mail reviews, and occasionally summarizing reviews in order to substantiate funding decisions. For example, mail reviews might be referred to as positive but general and lacking in detail whereas a careful reading of the mail reviews might show the review to have been thoughtful, thorough and detailed. In contrast, decision documentation by Dave Fountain was found to be clear and detailed, with thoughtful summary and evaluation of mail reviews.

A major deficiency in the documentation process has been the panel summaries. For the March 2001 proposals, summaries were cursory and lacking in detail. This was especially problematic in cases where the panel ranking differed significantly from the mail reviews. In such cases it is imperative that the panels deal thoughtfully with the issues, positive and negative raised by the mail reviewers. There appeared also to be a trend where panel evaluations of proposals that fell outside the areas of panel expertise were assigned arbitrarily low, or in at least one case high, panel rankings without reference to mail reviews that were at odds with the panel ranking. This is partly an issue of documentation and partly an issue of panel breadth and the overall scope of the Tectonics program, which are discussed in other subsections of this Tectonics program overview.

As of March 2002, the Tectonics program has shifted to the use of Fastlane for dispersal of mail reviews to the panel and for interactive preparation of panel summaries during

panel meetings. This should greatly improve the quality and detail of panel summaries. We encourage particular attention be paid to proposals in the gray area and to proposals with divergent mail and external reviews.

Feedback to PIs

Feedback to proposal PIs has suffered from many of the difficulties described above under decision documentation. A key point in improving PI feedback will be the improvement of panel summaries to include comments on and evaluation of mail reviews, detailed assessment of the proposal by the panel, and the basis for that assessment, and guidance to the PI for ways in which the proposal might be strengthened, where appropriate. We also recommend that the PD summary on Form 7 (with reviewers referred to anonymously) be forwarded to the PI along with the mail reviews and panel summary.

Balance

The balance and diversity of external reviewers was excellent, both in terms of expertise, geographic distribution and gender. Ethnicity is difficult to balance due to the lack of underrepresented minorities in the Earth Sciences generally, but the reviewer pool is at least reflective of the broader earth science community. Balance on the panel, which contains 6 regular panel members and, as of very recently, 1 junior, one-time member, is also good in terms of geographic distribution and gender, with at least one woman sitting on the panel. Expertise is well balanced in the areas that the Tectonics program has traditionally funded which is predominantly in the area of structure and tectonics, and related fields of petrology and geochronology. However, it is the opinion of the COV that the panel is lacking in breadth and does not represent some of the recent exciting advances in the study of tectonics, notably in the application of geophysical methods to solving tectonic problems, geodesy, dynamic analysis and modeling. This largely reflects the failure of the program to adapt to advances in the field and is discussed further under the section below on program content.

Of particular note is the fact that the Tectonics program funds considerable geologic field work, and is the predominant funding source for structural mapping in the United States, at least within the academic community. It is imperative that, while incorporating recent advances in the tools and techniques used to address tectonic problems, the program also retain its emphasis on basic field programs and that this be reflected in the panel membership.

Overall Technical Management

For the last decade the Tectonics program has functioned with one permanent PD and one rotator. This is a minimum level for handling of the proposal load received by the program. Because of the huge disciplinary range of proposals received by Tectonics, we recommend that the rotator PD (or second permanent program officer) have expertise in

an area that complements that of the permanent PD to facilitate a balanced treatment of proposals in a variety of disparate disciplines.

Because the purview of the Tectonics program is defined by process rather than by disciplinary tools, there are broad gray areas between the Tectonics Program and the programs that fund geophysics, geochemistry and, increasingly, geomorphology. It is critical for the PDs in Tectonics to cultivate a close working relationship with the PDs of the relevant programs to decide where and how proposals may be most fairly reviewed, and arrange for joint review and/or split funding as appropriate. This is particularly true for proposals that use geophysical or modeling approaches to understanding tectonic processes. Although the situation is better than in the past, it is still true that individual investigator proposals in this important and rapidly expanding research area have no natural home within EAR.

Program Content (Quality/Results)

The Tectonics program funds a wide variety of disciplinary studies, whose commonality is that they are designed to study lithospheric processes, modern and ancient. Work funded by the program has been of excellent quality, focussing on first-rate problems around the globe, and on ancient and active tectonics systems. Publications resulting from these studies have, for example, appeared in *Nature* and *Science* as well as top-rated earth science journals. The Tectonics program serves the important function of funding geological fieldwork around the world. NSF is almost the only source of funding for geological fieldwork in the United States, and it is imperative that the funding of basic field mapping remains an important part of the portfolio of the Tectonics program.

At the same time, the Tectonics program has attempted to evolve and broaden as earth scientists have increasingly addressed tectonics problems through a wide range of geochemical, geodetic, geophysical and modeling approaches, often but not always combined with field studies. In this regard the Tectonics program has a strong history of funding geochronological and petrologic studies, which are often directly related to geological mapping efforts within the same project. Tectonics has been less successful at incorporating research into tectonically important problems through the use of geophysical and modeling studies, although there are some nice examples of modeling and regional GPS studies funded through the Tectonics program. We strongly encourage that the expertise of the Tectonics panel be broadened to incorporate someone with expertise in the fields of dynamic modeling, seismology, GPS and general geophysics.

Program content within Tectonics is not only a matter of panel composition, but also a matter of public perception within the Earth Science community, where the Tectonics Panel is viewed largely as a funding vehicle for the structure and tectonics community. There is a widespread perception that, despite the stated aims of the Tectonics program, that more geophysically- or quantitatively-oriented studies do not have an equal chance for funding based on the merits of the proposed work. This is especially unfortunate in that many of the exciting advances in the field of tectonics are now coming at the interface of geology and tectonics with other disciplines and with modeling efforts. It is

the opinion of the COV that the long-term health of the tectonics community will be best served by ensuring that proposals for such studies have a natural home within EAR, in fact as well as in the minds of the earth science community.

This is a time of great change within the Tectonics program and offers opportunities to broaden and strengthen the research funded by the program. We particularly recommend broadening the makeup of the tectonics panel, strengthening ties between Tectonics, Geophysics and other relevant programs, improving documentation and PI feedback to assure PIs of the fairness of the review and funding process, and by communication and outreach of the new PD to the earth science community.

CONTINENTAL DYNAMICS (CD)

Proposal Processing

CD differs from the other 5 EAR Programs in the encouragement of prospective PIs to submit pre-proposals to test whether there is support from the panel for their research concept. Given the often substantial effort involved in organizing a large number of investigators and given the community-wide impact of the cost of successful CD projects, it is prudent to establish from the outset whether there is some likelihood that community support can be achieved for the project. Pre-proposals favorably received by the panel are given extensive advice on how best to organize the project including comments not only on science justification, but also on work plan and personnel. A given project typically requires more than one round of mail and panel review before consensus has been achieved on an award decision. Thus, a successful CD project for which an award is made is the product of extensive consultation and deliberation. The COV supports this approach, and views it as an overall benefit for the community. The success rate during the 1999-2001 interval was 33% (Table 6).

External reviews

External reviews are generally of high quality, and tap the technical breadth and diversity of the community. The average number of mail reviews per proposal has increased to 5.5 in 2001 from 3.0 in 2000 (3.8 in 1999). The COV strongly recommends that this level of reviews should be maintained, considering the nature of CD projects. The CD panel review summaries are very good, and are arguably the most detailed and substantive in EAR and could serve as a model for other programs.

Decision documentation

Documentation in the proposal jackets is good, but not as thorough and well organized as in other EAR programs. For example, copies of key emails and notes on important phone calls with PIs are not regularly included in the jacket. Records of key communications between the PD and PIs should be archived in the project jacket and not just held in the memories of persons involved. Clear documentation is important for evaluation by future COVs and any future CD Program Directors.

Although evaluation of pre-proposals is apparently a major effort for this program, there was no documentation on that aspect of the evaluation process. It was therefore difficult for the COV to form an opinion on the fairness and objectives of the pre-proposal selection process.

Feedback to PIs

Feedback to PIs for awarded and declined proposals is primarily provided by telephone, as discussed by the Program Director in his COV presentation. Based on general community perceptions, this oral feedback appears to work adequately. However, the COV strongly recommends that written substantive feedback be provided to funded and non-funded PIs, as is done in all other EAR programs. This could take the form of excerpted text from the panel summary, plus some information on relative ranking.

Balance

There is a good balance of senior and junior researchers, and a healthy balance of institutions from the range of academic tiers in the community, represented in funded CD research. Most funded projects are of long duration, with the Hawaii Scientific Drilling Program (HSDP) being the most extreme example at 7 years. This is appropriate, given the charter of the CD program. This is also consistent with other EAR programs that are moving to longer-term funding for both scientific and administrative reasons.

Funding of large new CD proposals has been and continues to be a programmatic challenge, due to continuing funding commitments to projects. Exhibits presented to the COV show continuing award obligations (“mortgage”) of 58.1% of total program funding in FY 2001. The Program Director forecasted a FY2002 CD mortgage near 52% in his presentation to the COV. Although it is difficult to set the optimum CD mortgage level, the COV supports this direction of decreasing CD mortgages in order to be able to accommodate new CD projects (large and small). Some mechanisms for achieving and maintaining a reduced mortgage level might include longer continuing funding periods, and pre-submission guidance from the Program Director to potential PIs to design smoother spending profiles in proposed multi-year projects, particularly for research that contains significant field activities.

The current panel size (9 members) and technical breadth (probably broadest in EAR) are appropriate, considering the size and complexity of CD proposals. The COV recommends continuing this panel structure. In addition, continuity of the panel is especially important in CD where most projects are multi-year

Overall technical management

The mechanics of Continental Dynamics (CD) proposal processing are working well. The COV examined all FY2001 CD projects that were reviewed in the 2000 panel meeting (13 separate and lumped proposals). Overall, the CD research award process

appears to be fair and just. The long “dwell time” for proposals that is exhibited in the CD award tables appears to be largely an artifact of the relative timing of submission and panel dates and the EAR internal budget allocation date, and was addressed for the FY2002 cycle. Staffing of the CD Program office is at the right level, although some consideration should be given to a CD Rotator for program continuity and eventual Program Director succession.

Program Content (Quality/Results)

The CD program has matured into a collection of primarily large projects, wherein first-order global processes are being studied effectively and basic earth science discoveries are being made. Other examples include the Kaapvaal Craton Project, (highlighted on the cover of Geophysical Research Letters, July 1991), where broadband seismic and other data are unraveling the Archean and later development of one of the Earth's major continental nucleation sites. This project also had a significant educational benefit for black South African students and junior scientists.

The ongoing work at Parkfield, California on the SAFOD pilot hole is progressing well, and will likely provide large science dividends in the near future. The INDEPTH I/II/III projects discovered unexpected high temperatures in the obducted slab of the Tibet Plateau, with major implications for mountain building. CD projects have a worldwide distribution, reflecting the exciting range of continental dynamics problems and opportunities available to researchers.

Outreach activities are especially opportune for CD projects. Project PI's have recently been filmed for public television documentaries including "Nanga Parabat: Naked Mountain" concerning the unusually rapid rise of a 26,600 ft mountain in the Pakistan Himalayas. This film has been distributed for broadcasts in the summer of 2002. The COV supports the Program Director's initiative to include increased funds in the original CD proposals for outreach activities of this and other kinds.

The current CD program is a response to the priorities of the earth sciences research community as expressed in the CD/2020 report prepared in 1989. Now that a dozen years have passed, and the CD Program has matured, the time is probably ripe for re-examination of the Continental Dynamics program concept. The COV recommends that a workshop be convened, along the lines of the 1989 activity that led to the CD Program, that is open to the broad earth science community and would seek input on directions for the future.

**Charge of the Committee of Visitors for the Division of Earth Sciences Programs
in:**

*Geology and Paleontology, Tectonics, Petrology and Geochemistry, Hydrologic
Sciences, Geophysics, and Continental Dynamics*

As described in more detail in the following document “Core Questions and Report Template”, for the three-year period from FY1999 to FY2001, this committee will:

1. Review actions taken by the programs.
2. Evaluate the products and contributions supported and overseen by the programs.
3. Review and comment on the effectiveness of the programs, areas needing improvement, and make recommendations for future action.

With respect to proposal actions (no. 1 above), the COV will examine:

1. The integrity and efficiency of processes used to solicit, review, recommend, and document proposal evaluation and actions, including the effectiveness of the programs’ use of NSF’s review criteria.
2. The relationship between award decisions and program goals.

Recent summaries of NSF’s performance goals and review criteria are provided in Tab 14 for reference.

CORE QUESTIONS and REPORT TEMPLATE
for
FY 2002 NSF COMMITTEE OF VISITOR (COV) REVIEWS

Guidance to NSF Staff: This document includes the FY 2002 set of Core Questions and the COV Report Template for use by NSF staff when preparing and conducting COVs during FY 2002. Specific guidance for NSF staff describing the COV review process is described in the recently revised Subchapter 300-Committee of Visitors Reviews (NSF Manual 1, Section VIII) which can be obtained at <http://www.inside.nsf.gov/od/gpra/>.

NSF relies on the judgment of external experts to maintain high standards of program management, to provide advice for continuous improvement of NSF performance, and to ensure openness to the research and education community served by the Foundation. Committee of Visitor (COV) reviews provide NSF with external expert judgments in two areas: (1) assessments of the quality and integrity of program operations and program-level technical and managerial matters pertaining to proposal decisions; and (2) the degree to which the outputs and outcomes generated by awardees have contributed to the attainment of NSF's mission, strategic goals, and annual performance goals.

The Core Questions developed for FY 2002 are a basic set of questions that NSF must respond to as a whole when reporting to Congress and OMB as required by GPRA. The questions are derived from the OMB approved FY 2002 performance goals and apply to the portfolio of activities represented in the program(s) under review. The program(s) under review may include several subactivities as well as NSF-wide activities. The directorate or division may instruct the COV to provide answers addressing a cluster or group of programs - a portfolio of activities integrated as a whole- or to provide answers specific to the subactivities of the program-with the latter requiring more time but providing more detailed information.

The Division or Directorate may choose to add questions relevant to the activities under review. *Not all core questions are relevant to all programs.* NSF staff should work with the COV members in advance of the meeting to provide them with organized background materials and to identify questions/goals that apply to the program(s) under review. NSF staff should help COVs to focus on questions or goals that apply to the program under review, and avoid questions which do not apply.

Guidance to the COV: The COV report should provide a balanced assessment of NSF's performance in two primary areas: (A) the integrity and efficiency of the **processes** which involve proposal review; and (B) the quality of the **results** of NSF's investments in the form of outputs and outcomes which appear over time. The COV also explores the relationships between award decisions and program/NSF-wide goals in order to determine the likelihood that the portfolio will lead to the desired results in the future. Discussions leading to answers for Part A of the Core Questions will require study of confidential material such as declined proposals and reviewer comments. *COV reports should not contain confidential material or specific information about declined proposals.* Discussions leading to answers for Part B of the Core Questions will involve study of non-confidential material such as results of NSF-funded projects. It is important to recognize that the reports generated by COVs are used in assessing agency progress in meeting government required reporting of performance, and are made available to the public.

Clear justifications for goal ratings are critical – ratings without justifications are not useful for agency reporting purposes. Specific examples of NSF supported results illustrating goal achievement or significant impact in an area should be cited in the COV report, with a brief

explanation of the broader significance for each. Areas of program weakness should be identified. *COV members are encouraged to provide feedback to NSF on how to improve in all areas, as well as the COV process, format, and questions.*

**FY 2002 REPORT TEMPLATE FOR
NSF COMMITTEES OF VISITORS (COVs)**

Date of COV: 12-14 August, 2002
Program/Cluster: 6 disciplinary programs
Division: Earth Sciences
Directorate: Geosciences
Number of actions reviewed by COV: 120 jackets

PART A. INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

Briefly discuss and provide comments for *each* relevant aspect of the program's review process and management. Comments should be based on a review of proposal actions (awards, declinations, and withdrawals) that were *completed within the past three fiscal years*. Provide comments for *each* program being reviewed and for those questions that are relevant to the program under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged. Please do not take time to answer questions if they do not apply to the program.

A.1 Questions about the quality and effectiveness of the program's use of merit review procedures. Provide comments in the space below the question. Discuss areas of concern in the space below the table.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCEDURES	YES, NO, or DAT A NOT AVAILABLE
<p>Is the review mechanism appropriate? (panels, ad hoc reviews, site visits)</p> <p>Comments: Each program of EAR operates with both ad hoc reviews and panel review, both of which are taken as advice to the program officer. At least three ad hoc reviews are obtained before a decision is made. Choice of ad hoc reviewers seems appropriate to the science proposed, and generally results in reviews from an appropriately diverse (with respect to gender, age, type of home institution) group of scientists.</p>	Yes

<p>Is the review process efficient and effective? Comments: The process is not efficient, in that it requires an enormous commitment of time and effort by the scientific community, but the results of the process justify this commitment. The process is effective in that the prevailing opinions of the <i>ad hoc</i> reviewers and the advice of the panels are followed in most cases. The proposals that are funded are of very high quality.</p>	<p>Yes</p>
<p>Is the time to decision appropriate? Comments: The proportion of proposals acted upon within six months of receipt varies from program to program within the division. In some programs (e.g., Tectonics) it has been consistently high. In other programs there is room for improvement. The performance of some programs (e.g., Geology and Paleontology) in this respect has improved markedly over the past three years as staffing has stabilized. Given the heavy proposal loads relative to ATM and OCE that must be handled by the EAR program officers, significant improvements in time to decision in some programs will require additional staffing.</p>	<p>Yes (qualified)</p>
<p>Is the documentation for recommendations complete? Comments: Documentation of recommendations is fair to adequate in all programs, and is outstanding in some.</p>	<p>Yes</p>
<p>Are reviews consistent with priorities and criteria stated in the program's solicitations, announcements, and guidelines? Comments: Reviews of the intellectual merits of proposals are consistent with program solicitations. Reviewers are less consistent in commenting on the broader impacts of proposed projects.</p>	<p>Yes</p>

Discuss issues identified by the COV concerning the quality and effectiveness of the program's use of merit review procedures:

Merit review procedures are used very effectively. No issues were identified.

A. 2 Questions concerning the implementation of the NSF Merit Review Criteria (intellectual merit and broader impacts) by reviewers and program officers. Provide comments in the space below the question. Discuss issues or concerns in the space below the table. (Provide fraction of total reviews for each question)

IMPLEMENTATION OF NSF MERIT REVIEW CRITERIA	% REVIEWS
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What percentage of <i>reviews</i> address the <u>intellectual merit</u> criterion?	100%
What percentage of <i>reviews</i> address the <u>broader impacts</u> criterion?	<50% (discuss)
What percentage of <i>review analyses</i> (Form 7's) comment on aspects of the <u>intellectual merit</u> criterion?	100%
What percentage of <i>review analyses</i> (Form 7's) comment on aspects of the <u>broader impacts</u> criterion? Many focus on education grad students as the sole impact.	50% (discuss)

Discuss any concerns the COV has identified with respect to NSF's merit review system.

The intellectual merit criterion is consistently addressed effectively by reviewers. The broader impacts criterion is sufficiently ambiguous and broad that it is often addressed by stating the obvious. Broader impact criteria seemed to have little influence in the decision process.

SELECTION OF REVIEWERS	YES , NO Or DATA NOT AVAILABLE
<p>Did the program make use of an adequate number of reviewers for a balanced review?</p> <p>Comments: It is evident that each program within EAR is making considerable effort in identifying appropriate numbers and types of reviewer for the evaluation process. This effort is well supported by the documentation provided by most of the program officers in the division. The effort, however, is meeting with variable success, particularly with respect to the mail review process and the size of one or two of the panels.</p>	Yes

<p>Did the program make use of reviewers having appropriate expertise and/or qualifications? Comments: It appears that with the exception of a very few individual proposals and one panel, the programs made efforts to, and were very successful at, engaging highly qualified reviewers. The exceptions on individual proposals appear to have resulted from non-response of the selected mail reviewers. The exceptional panel resulted from the larger breadth of proposals presented to a panel than could be sensibly covered by the number of individuals on that panel.</p>	<p>Yes</p>
<p>Did the program make appropriate use of reviewers to reflect balance among characteristics such as geography, type of institution, and underrepresented groups? Comments: The documents provided to the COV demonstrate that efforts were made by each program to include under-represented groups, and to some degree geographic distribution. Notable exceptions were the lack of individuals from historically African American institutions. Underrepresented groups came primarily from established research institutions.</p>	<p>Yes</p>
<p>Did the program recognize and resolve conflicts of interest when appropriate? Comments: As a whole, the integrity of the review process with respect to conflicts of interest was excellent. This was true across the boards for the mail review and program officers. EAR might internally discuss the differences among programs in how they handled conflicts and encourage adoption of a “best practices” approach for consistency. In one program, the panel does not review proposals of panelists, relying instead on mail reviews. There is potential for this procedure to be perceived as unfair.</p>	<p>Yes</p>
<p>Did the program provide adequate documentation to justify actions taken? Comments: There is a degree of variability in the degree and quality of documents justifying actions taken by some of the programs. Most programs provided adequate to excellent documentation on the actions taken. Programs where documentation was not adequate appear to be in the process of upgrading their efforts in this category.</p>	<p>Yes</p>

Discuss any concerns identified that are relevant to selection of reviewers in the space below.

The COV noted several situations where increasing the number and/or types of individuals included in both the mail and panel review process would enhance the quality, efficiency, and integrity of the EAR review process. Suggestions include:

1. Broader contact and inclusion of industry, government laboratory, and or public sector scientists..
2. Addition of one more panel member in one or two programs.
3. Seek avenues for inclusion and/or mentoring of underrepresented groups in the review process.

A.4 Questions concerning the resulting portfolio of awards under review. Provide comments in the space below the question. Discuss areas of concern in the space below the table.

<p align="center">RESULTING PORTFOLIO OF AWARDS</p>	<p align="center">APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</p>
<p>Overall quality of the research and/or education projects supported by the program. Comments: As summarized in the reports for the individual programs, the COV was greatly impressed with the excellent results being achieved in every Program. EAR awards are leading to advances of major scientific or engineering importance. Proposals from the EAR community are being disproportionately funded in multidisciplinary competitions within NSF.</p>	<p align="center">Appropriate</p>
<p>Are awards appropriate in size and duration for the scope of the projects? Comments: Programs are attempting to increase the size and extend the duration of projects, but there are conflicting forces affecting this move.</p> <p>All EAR programs would support more projects if they had additional resources. There are more proposals worthy of funding in every program than there are funds to support them. A sizable percentage, perhaps the majority, of funded proposals are funded at lower than requested levels of support. This results in investigators having to return more frequently to NSF with additional proposals.</p> <p>Program directors are trying to “mortgage” program budgets to more fully fund worthy proposals or stretch the duration of them in order to reduce the workload in reviewing many shorter duration, smaller cost proposals. This, however, results in less money being available to support competing proposals during that funding round and reduces the success rate.</p> <p>The COV has a perception that larger, longer term proposals would be forthcoming from the scientific community if there were a sense that they would be funded.</p> <p>As long as most of the program staff is overloaded and the programs are under-funded, there will be problems in setting appropriate award size and duration.</p>	<p align="center">Appropriate</p>

<p>Does the program portfolio have an appropriate balance of</p> <ul style="list-style-type: none"> • High Risk Proposals <p>Comments: <i>General</i> – Programs do not characterize proposals as either high-risk or innovative so any analyses by the COV are subjective and non-quantitative. Some multidisciplinary proposals are targeted to specific defined programs so they were more easily recognized or were highlighted by EAR staff in presentations and materials.</p> <p><i>High Risk Proposals</i> - In a number of cases in different programs, especially in gray area proposals, well-known or well-established researchers were selected for funding while similarly ranked proposals by new or unknown investigators were denied, because the panel or the PO “trusted” the PI to resolve the proposal shortcomings because the PI had a demonstrated track record. In effect, those programs were preferentially investing in the lower risk proposals in the gray areas. There is justification for this approach but it should be acknowledged and appreciated. When such decisions are made, the programs may want to consider allocating some resources for similarly ranked high-risk (i.e., less known PI’s) proposals. In at least one case, a proposal was declined because reviewers explicitly desired a greater level of details in proposed methodology than from other proposers because the PI was new and unproven.</p> <p>One outcome of preferentially supporting established researchers is to lessen the support available for under-represented groups, who tend to be newer to the system.</p> <p>The COV did not recognize specific efforts in any programs to target or single out high-risk proposals for separate treatment.</p> <p>NOTE: THIS ADDRESSES HIGH RISK INVESTIGATORS, NOT HIGH RISK IDEAS</p>	<p>Appropriate</p>
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<ul style="list-style-type: none"> • Multidisciplinary Proposals <p>Comments: <i>Multidisciplinary Proposals</i> – The 1998 COV gave the highest priority to disciplinary programs but indicated that more needs to be done to promote multidisciplinary or interdisciplinary efforts. We paraphrase from the comments of the previous COV: <i>We believe that multidisciplinary scientific initiatives with great potential for exciting discovery will continue to evolve and that EAR must find ways to foster and sustain such initiatives. Although cross-division proposals may require special handling, we think that existing programs must find ways to cooperate even more fully and openly than they do at the present. The management of EAR must create and sustain an environment that encourages and facilitates consideration of proposals that span traditional disciplines. It is likely that a higher standard of cooperation among Programs than was needed in the past will be necessary.</i></p> <p>Despite strong division and directorate statements in support, multidisciplinary research appears to be treated in an ad hoc basis within EAR with any attempts to address specific proposals dependent on personal relations among Program Officers.</p> <p>Each program runs its submission and review schedule and process independently, which emphasizes disciplinary projects and discourages multidisciplinary proposals.</p> <p>There is no apparent explicit EAR strategy or plan to promote multidisciplinary projects within EAR. There are however, exceptionally successful results in multidisciplinary research by the EAR scientific community across the rest of NSF. Funding return to earth science investigators from the ITR and BE (?) programs for example, has been substantially greater than the internal transfer of funds (“taxes”) from EAR to these programs. EAR has also done well in competition for Science and Technology Centers over the past decade or so.</p>	<p>Appropriate</p>
<ul style="list-style-type: none"> • Innovative Proposals <p>Comments: <i>Innovative Proposals</i> – There is widespread and pervasive belief throughout EAR and reviewers in funding the best science. By inference, this leads to innovative ideas and approaches by investigators in competing for limited funds. However, the intense competition also means that every proposal is under intense scrutiny for any lapses or shortcomings that could lead to eliminating it from consideration.</p> <p>Innovation and risk may go hand in hand to some extent. Innovation generally requires novel ideas, methodologies, and approaches that are untried and inherently riskier than simply applying known methods to different areas. This may tend to self-select proposals that are less radical and demonstrate a greater certainty of success.</p> <p>None of the EAR programs identify innovation as a target for consideration in the review process.</p>	<p>Appropriate</p>

<p>Of those awards reviewed by the committee, what percentage of projects address the integration of research and education?</p> <p>Comments: Almost every proposal reviewed integrated education of masters and doctorate level graduate students into the research projects. In fact, the integration was so pervasive and integral to the success of the proposals that the committee saw it as the implicit standard used by proposers.</p>	<p>Percentage: 90+%</p>
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Discuss any concerns identified that are relevant to the quality of the projects or the balance of the portfolio in the space below.

PART B. RESULTS : OUTPUTS AND OUTCOMES OF NSF INVESTMENTS

NSF investments produce results that appear over time. The answers to questions for this section are to be based on the COV's study of award results, which are direct and indirect accomplishments of projects supported by the program. These projects may be currently active or closed out during the previous three fiscal years. The COV review may also include consideration of significant impacts and advances that have developed since the previous COV review and are demonstrably linked to NSF investments, regardless of when the investments were made. Incremental progress made on results reported in prior fiscal years may also be considered.

The attached questions are developed using the NSF outcome goals in the 2002 Performance Plan. The COV should look carefully at and comment on (1) noteworthy achievements of the year based on NSF awards; (2) the ways in which funded projects have collectively affected progress toward strategic outcomes; and (3) expectations for future performance based on the current set of awards. NSF asks the COV to reach a consensus regarding the degree to which past investments in research and education have measured up to the annual strategic goals.

The COV's should address each relevant question. Questions may not apply equally to all programs. COVs may conclude that the program under review appropriately has little or no effect on progress toward a strategic outcome, and should note that conclusion in the COV's report.

The following report template provides the broad FY 2002 Strategic Outcomes for People, Ideas and Tools, the FY 2002 performance goals for each outcome, and the specific indicators used to measure performance in meeting the annual performance goal. If the COV members are not sure how to interpret the goal or indicators for the particular program, they should request clarification from the NSF program staff.

To justify significant achievement of the outcome goals and indicators, COV reports should provide brief narratives, which cite NSF-supported examples of results. For each NSF example cited, the following information should be provided in the report:

- NSF Award Number
- PI Names
- PI Institutions
- Relevant Performance Goal/Indicator
- Relevant Area of Emphasis
- Source for Report

B.1.a COV Questions for PEOPLE Goal

NSF OUTCOME GOAL for PEOPLE: Developing “a diverse, internationally competitive and globally engaged workforce of scientists, engineers, and well-prepared citizens.”

Consider each of the seven indicators for the PEOPLE goal. Has the activity supported projects that demonstrate significant achievement for the PEOPLE outcome goal indicators? To justify your answer, provide NSF-supported examples for each of the relevant indicators that apply to the activity and explain why they are relevant or important for this outcome in the space following the table. If projects do not demonstrate significant achievement, comment on steps that the program should take to improve. Please do not discuss if the indicator is not relevant to the activity.

PEOPLE GOAL INDICATORS	<p>PROGRAM ACHIEVEMENT</p> <p>SIGNIFICANT, OR NOT SIGNIFICANT , OR DOES NOT APPLY, OR DATA NOT AVAILABLE (select one)</p>
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<p>Development of well-prepared scientists, engineers or educators whose participation in NSF activities provides them with the capability to explore frontiers and challenges of the future;</p> <p>Comments: A high proportion of research awards includes a post-doctoral or graduate student training component. Some include undergraduate research opportunities as well. Career awards provide important research/teaching development opportunities for early career faculty members.</p>	<p>If Significant Significant, provide award #s EAR 0106054 EAR 0106477 EAR 9901694</p>
<p>Improved science and mathematics performance for U.S. K-12 students involved in NSF activities;</p> <p>Comments:</p>	<p>Not significant in the proposals reviewed by the COV Significant, provide award #s</p>
<p>Professional development of the SMET instructional workforce involved in NSF activities;</p> <p>Comments:</p>	<p>Not significant in the proposals reviewed by the COV If Significant, provide award #s</p>
<p>Contributions to development of a diverse workforce through participation of underrepresented groups (women, underrepresented minorities, persons with disabilities) in NSF activities;</p> <p>Comments: EAR does a good job in tracking and documenting the success of women and minorities who submit proposals. Approximately 15 percent of proposals (between 10 and 20 percent in individual programs) in 1999-2001 were submitted by women and 3 percent were submitted by minorities. The funding rates of those proposals were comparable to those of the total pool of proposals. The COV saw no data concerning the participation of persons with disabilities. Neither did the COV see data that would permit a comparison of the numbers of women and minorities in the Earth Sciences community with the numbers of women and minorities who submit proposals to the division.</p>	<p>Significant If Significant, provide award #s EAR 9701768 EAR 0106883 EAR 0106089</p>
<p>Participation of NSF scientists and engineers in international studies, collaborations, or partnerships;</p> <p>Comments: There is a great deal of international activity at all levels. This is not limited to field-related activities, although the field aspects of the earth sciences particularly lend themselves to international collaborations and partnerships.</p>	<p>Significant If Significant, provide award #s EAR 9975339 EAR 9706086</p>

<p>Enhancement of undergraduate curricular, laboratory, or instructional infrastructure;</p> <p>Comments: Approximately 4 percent of the proposals were from undergraduate (only) institutions. The success rate of these was comparable to that of the total proposal pool. Many of these proposals involve undergraduates in research and include improvements to the laboratory infrastructure encountered by undergraduates, particularly with respect to research laboratory infrastructure.</p>	<p>Significant If Significant, provide award #s EAR 0207750 EAR 0106223 EAR 0101314</p>
<p>Awardee communication with the public in order to provide information about the process and benefits of NSF supported science and engineering activities.</p> <p>Comments: Communication with the public in the form of press-releases and interviews with the press is common. It is mostly done through the individual initiative of investigators or the public relations offices of their institutions. Additional communication with the public about particularly high-profile activities is initiated by EAR.</p>	<p>Significant If Significant, provide award #s EAR0106477 EAR 9714923 EAR 9902830 EAR 8920136 EAR 0004370</p>

Provide one or more examples of NSF supported results with award numbers to justify each selection above. For each example, provide a brief narrative, to explain the importance of the result in non-technical terms. For each NSF example cited, include the following information:

- NSF Award Number
- PI Names
- PI Institutions
- Relevant Performance Goal/Indicator
- Relevant Area of Emphasis
- Source for Report

B.1.b COV Questions related to PEOPLE Areas of Emphasis

For each relevant area shown below, determine whether the program’s investments and available results demonstrate the likelihood of strong performance in the future? Justify your argument by providing NSF-supported examples of investment results (with grant numbers) that relate to or demonstrate outcomes for the PEOPLE goal and relevant indicators. If the area of emphasis is not relevant to the activity, do not discuss.

<p>PEOPLE AREAS OF EMPHASIS</p>	<p>Demonstrates likelihood of strong performance in future? (Yes, No, Does Not Apply or Data Not Available)</p>
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K-12 Education -President's Math and Science Partnership Comment: These items are addressed by the Education and	Does Not Apply If Yes, provide award #s
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Human Resources Program (E&HR), which is covered under a separate COV.	
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<p>Learning for the 21st Century:</p> <ul style="list-style-type: none"> • Centers for Learning and Teaching (CLT) • NSF Graduate Teaching Fellows in K-12 Education (GK-12) <p>Comments: These items are addressed by the Education and</p>	<p style="text-align: center;">Does Not Apply If Yes, provide award #s</p>

Human Resources Program (E&HR), which is covered under a separate COV.	
<p>Broadening Participation</p> <ul style="list-style-type: none"> • Minority-Serving Institutions (MSI) programs <p>Graduate Student Stipends</p> <ul style="list-style-type: none"> • Increasing stipends for GRF, IGERT, and GK-12 <p>Comments: These items are addressed by the Education and</p>	<p style="text-align: center;">Does Not Apply If Yes, provide award #s</p>

Human Resources Program (E&HR), which is covered under a separate COV.	
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Provide one or more examples of NSF supported results with grant numbers to justify each selection above. For each example, provide a brief narrative to explain the importance of the result in non-technical terms. For each NSF example cited, include the following information:

- NSF Award Number
- PI Names
- PI Institutions
- Relevant Performance Goal/Indicator
- Relevant Area of Emphasis
- Source for Report

Comment on steps that the program should take to improve performance in areas of the PEOPLE goal.

B.2.a COV Questions for IDEAS Goal

NSF OUTCOME GOAL for IDEAS: Enabling “discovery across the frontier of science and engineering, connected to learning, innovation, and service to society.”

Consider each of the six indicators for the IDEAS goal in the table below. Has the activity supported projects that demonstrate significant achievement for the IDEAS outcome goal indicators? Complete the table below for each program reviewed. To support your results in the table, provide NSF-supported examples for each of the relevant indicators that apply to the activity and explain why they are important for the IDEAS outcome. If projects do not demonstrate significant achievement, comment on steps that the program should take to improve. Do not discuss if indicator is not relevant to the activity.

<p style="text-align: center;">IDEAS INDICATORS</p>	<p style="text-align: center;">PROGRAM ACHIEVEMENT</p> <p style="text-align: center;">Select one: SIGNIFICANT, NOT SIGNIFICANT, DOES NOT APPLY or DATA NOT AVAILABLE</p>
<p>Discoveries that expand the frontiers of science, engineering, or technology;</p> <p>Comments:</p> <p>EAR programs documented discoveries in different ways and to varying degrees of detail, but it is clear that across the board, EAR funded projects are significant sources of the leading discoveries in the earth sciences.</p> <p>Petrology and Geochemistry (CH) demonstrated that research articles generated from funded projects were prominent in journals of broad interest (16 in <i>Nature</i>, 18 in <i>Science</i>, 80+ in <i>Earth and Planetary Science Letters</i>) and dominant in the leading specialty journals (45 of 55 US contributions, 187 total papers in <i>Journal of Petrology</i>; 45 of 55 US contributions, 188 total papers in <i>Contributions to Mineralogy and Petrology</i>; 100 of 220 US contributions, 433 total papers in <i>American Mineralogist</i>; and 33 of 149 US contributions, 433 total papers in <i>Journal of Volcanology and Geothermal Research</i>).</p> <p>Support of studies of mineral structures and synthetic compounds led to a continuing revolution of methodologies to study mineral and glass structure.</p> <p>In the last three years, studies have led to several innovative techniques for geochemical and petrological analyses that open a large range of possibilities for the development of new geochemical tracers and isotopic systems.</p>	<p>Significant If Significant, provide award #s EAR-9814333 EAR-9903349 EAR-9814819 EAR-9526344 EAR-9614457</p>

Discoveries that contribute to the fundamental knowledge base;

Comments: Example: Early Evolution of the Cetaceans (Whales) funded by EAR Geology and Paleontology

Three articles published in *Science* and *Nature* this year by two groups of scientists point out great advances being made in understanding the early history of cetaceans (whales). These studies have been supported by grants in the Earth Science Division. Two were published in different journals on the same day—one by Philip Gingerich and colleagues at the University of Michigan (*Science*) and another by J. G. M. Thewissen and colleagues from the Northeastern Ohio Universities College of Medicine (*Nature*). Both arrive independently at the same startling conclusions about the early evolution of whales based on new fossil finds in Pakistan. Whales evolved approximately 50 million years ago from land-based even-toed ungulates (hoofed animals) rather than mesonychians (an extinct group of carnivorous ungulates) as has been traditionally believed. These fox- and wolf-sized four-footed animals were surface paddlers in the shallow seas of Eocene time that evolved into modern whales. A later study in *Nature* by Thewissen and colleagues documented the early evolutionary development of small semicircular canals in cetaceans that opened an entirely new mammalian niche for habitation leading to the broad diversity of marine living habits that whales inhabit and dominate today. The evolutionary acquisition of such specialized organs or abilities (for example, the brain and upright walking habit of man) provide mechanisms by which highly evolved organisms dominate in certain environments to the exclusion of others.

Significant
If Significant, provide award #s
EAR 9714923
EAR 9902830

<p style="text-align: center;">Leadership in fostering newly developing or emerging areas;</p> <p>Comments: EAR programs routinely encourage and support workshops and conferences to broach newly developing and emerging areas. For example, Geology and Paleontology (GE) supported 10 workshops between 1999-2001. Coming up shortly in the Tectonics program (TE) are a one-day workshop to define avenues of research in structural geology and tectonics that hold the most promise for advances in the next decade, and a workshop on Priorities in the Solid Earth Sciences.</p> <p>A second arena is support for special issues of journals to focus attention on emerging areas. An example is the May 10, 2002 special issue of <i>Science</i> on Environmental Biology that reflected the enormous expansion of interest among geoscientists in the field of microbiology (“geobiology”). Two News stories and six articles in the Reviews and Viewpoints sections summarized the scale of activity of microorganisms, their ubiquity, and the extent to which all of life and the operation of the geosystem relies upon them. Prominent among the researchers presenting these results was Dr. Jillian Banfield (U.C. Berkeley) whose work has received significant funding through EAR. Dr. Banfield’s paper on “How Molecular-Scale Interactions Underpin Biogeochemical Systems” represents research funded over a long period by NSF/EAR. The continuity of her funding record demonstrates both her excellent record of research productivity and the commitment of NSF/EAR to fostering fundamental research that may require years for the complete impact to become manifest. Several other NSF-funded researchers authored papers in this special issue.</p>	<p>Significant If Significant, provide award #s EAR 0123967 EAR 0106054 EAR 9814333 EAR 9706832</p>
<p style="text-align: center;">Connections between discoveries and their use in service to society;</p> <p>Comments: Volcanic hazard and monitoring studies (CH) links basic research in volcanology with potential improvements in hazard assessment through the utilization of GPS to monitor volcano deformation and instability. In addition, funded projects apply a variety of new instruments as monitors of hazardous gas emanations from volcanic areas. Other studies monitor ash in the atmosphere (air-traffic hazard) by remote sensing techniques.</p>	<p>Significant If Significant, provide award #s EAR 9996015 EAR 9972937 EAR 9972922 EAR 9814312</p>

<p style="text-align: center;">Connections between discovery and learning or innovation;</p> <p>Comment: Recent awards from the Petrology and Geochemistry Program (CH) and the ITR program of NSF/CISE represent the very close connection between basic scientific research and discovery and learning and technological innovation.</p> <p>Retrospective - The risk of potential rock avalanches and pyroclastic flows is a problem that public safety authorities around the world face constantly. The award to Dr. Michael Sheridan funded the development of a 3-D computer program to simulate the flow from geologic avalanches. The program uses estimates of original volume of the starting materials and their properties and accurate digital terrain model of the surface. The model forecasts simulated avalanches, all in three dimensions. Two graduate and one undergraduate students were involved in the research that produced a published journal article and book. Detailed public information is available through a website, which was also funded by this award (www.vrlab.buffalo.edu/visual).</p> <p>Prospective – The ITR award to Dr. Abani Patra (SUNY Buffalo) is a direct outcome of the EAR award to Dr. Sheridan. The principal investigators of the current grant will develop a Real-time Environmental Observation and Forecasting System (EOFS) that will revolutionize the way scientists share information about the environment and represent an opportunity to break traditional information barriers separating scientists from society at large. EOFS's are already in use, but they tend to be small-scale, application- and domain-specific, stand-alone systems. There is a need for evolution towards multi-purpose shared systems designed to adapt flexibly to evolving needs of information consumers. What is required are large-scale, shared, heterogeneous distributed systems that make extensive use of diverse sensor based inputs, sophisticated numerical simulations, mobile and embedded real-time system components, wireless and wired communications, high-performance computers, and high capacity storage systems.</p> <p>This ITR medium project has assembled an inter-disciplinary team, including computer science and environmental science researchers in addition to a heterogeneous base of pilot users. This group will collaborate to develop software technology to deliver quantifiably reliable information about the environment at the right time and in the right form to the right users.</p>	<p>Significant If Significant, provide award #s EAR 0087665 ITR 0102805</p>
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Partnerships that enable the flow of ideas among the academic, public or private sectors.

Comments: The COV suggests that it would be fruitful for EAR to re-examine its philosophy and mechanisms in place for facilitating cooperative research by PIs with industry. This suggestion is driven by a number of factors, including: 1) the large number of technical areas in which EAR programs share common ground with activities in industry, 2) the very large amounts of industry geoscience data, 3) the guidance that is often given to PIs by EAR program panels to coordinate better with industry in their research projects, and 4) the movement within several large petroleum companies to increase their research leveraging with the academic community. With the possible exception of drilling issues handled through DOSSEC, in most cases PIs essentially fend for themselves to scope industry resources, identify staff contacts, build relationships, and finally gain access to industry resources. This can be an arduous process that requires considerable pre-investment of time and money prior to research funding. Similar (and different) problems occur on the industry side. Thus it may be beneficial to consider initiating an EAR effort that would facilitate such activities by potential and existing PIs, thereby benefiting both EAR basic research and industry activities. This EAR industry interface activity should be administered at the Division level, and could easily become a full-time activity for one senior EAR staff member. Coordination with similar activities at the American Geological Institute (AGI) should be examined. A similar NSF-wide industry initiative could also be considered.

Similar opportunities and challenges exist in EAR's interactions with the public sector. Partnerships exist with the U.S. Geological Survey and NASA for example, but many other federal and state agencies have the need for the kind of scientific studies that EAR can provide. These agencies can often provide cost share or other forms of support to investigators.

More partnerships among the academic, public, and private sectors will also lead to improved and expanded benefits of the research in service to society.

Significant
If Significant, provide award #s
EAR 8920136

Provide one or more examples of NSF supported results with grant numbers to justify each selection above. For each example, provide a brief narrative to explain the importance of the result in non-technical terms. For each NSF example cited, include the following information:

- NSF Award Number
- PI Names
- PI Institutions
- Relevant Performance Goal/Indicator
- Relevant Area of Emphasis
- Source for Report

B.2.b COV Questions related to IDEAS Areas of Emphasis

For each relevant area shown below, determine whether the program’s investments and available results demonstrate the likelihood of strong performance in the future? Justify your argument by providing NSF-supported examples of investment results (with grant numbers) that relate to or demonstrate outcomes for the IDEA goal and relevant indicators in the space below the area of emphasis. If the area of emphasis is not relevant to the activity, do not discuss.

IDEAS AREAS OF EMPHASIS	Demonstrates likelihood of strong performance in future? Select one: Yes, No, Does Not Apply or Data Not Available
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Biocomplexity in the Environment

Comments: NEW NSF BIOGEOSCIENCES INITIATIVE

The NSF Directorate for Geosciences has initiated a new Directorate-wide activity in support of fundamental research in biogeoscience. Biogeoscience explores how organisms influence and are influenced by the Earth's environment and the emergence of this discipline is characterized by conceptual and technological advances opening new avenues of research. Scientific opportunities inherent in biogeoscience span the gulf that has traditionally separated the Geosciences from the Life Sciences. A significant body of scientists is beginning to bridge those disciplinary differences in vocabulary, technique, and scientific paradigm. The NSF program in Biogeoscience encourages further exploration of coupled biogeosystems, taking advantage of new techniques and creating opportunities for advancement.

This activity recognizes the extraordinary growth that has occurred at the interface of the biological and geological sciences, which has become one of the most intellectually stimulating and challenging frontiers in science. It also furthers the goal of the Directorate for Geosciences "...to advance the scientific understanding of the integrated Earth systems ..." (NSF Geosciences Beyond 2000", NSF 00-27; <http://www.geo.nsf.gov/adgeo/geo2000.htm>).

The National Academy of Sciences has placed a high priority on research in the Biogeosciences. Specific recommendations are detailed in "Basic Research Opportunities in the Earth Sciences" (2001, NRC). This report identifies two specific areas in which opportunities for basic research are especially compelling: (1) Integrative studies of the "Critical Zone" - the near surface environment in which complex interactions involving rock, soil, water, air and living organisms regulate the natural habitat and determine the availability of life-sustaining resources; and (2) Geobiology - the study of how life interacts with the Earth and how it has changed through geologic time. Advances in both of these areas are dependent upon developments in Biogeosciences.

These reports project the continued emergence of the biogeosciences in the next decade, summarize the current knowledge and identify action for advancing this aspect of environmental sciences. NSF is responding to this need by preparing a program announcement soliciting proposals in this area with first year funding at \$4-5M. An IPA position has been established to coordinate the GEO-wide activity for "Biogeoscience and the Carbon Cycle" and the new program officer, Dr. Rachael Craig, assumed her position on May 20, 2002.

**If Yes, provide award #s
Data not available**

Information Technology Research

Comments:

It is now possible, because of recent advances in geophysics, to create for the first time, fully three-dimensional simulations of earthquake fault-rupture and fault-system dynamics. Such physics-based simulations are crucial to gaining a fundamental understanding of earthquake phenomena, and they can potentially provide enormous practical benefits for assessing and mitigating earthquake risks through improvements in seismic hazard analysis. The Southern California Earthquake Center (SCEC) has embarked on an ambitious program to develop physics-based models of earthquake processes and integrate these models into a new scientific framework for seismic hazard analysis and risk management. The project represents a collaboration among SCEC, the Information Sciences Institute (ISI), the San Diego Supercomputer Center (SDSC), the Incorporated Research Institutions for Seismology (IRIS), and the U.S. Geological Survey (USGS) to develop a "Community Modeling Environment", which will function as a virtual collaboratory for the purposes of knowledge quantification and synthesis, hypothesis formulation and testing, data assimilation and conciliation, and prediction.

To achieve its objectives, the environment must provide a means for describing, configuring, initiating, and executing complex computational pathways that result from the composition of various earthquake simulation models. This entails solving a number of challenging problems in information technology. To solve these problems, the principal investigators will draw on several distinct computer science disciplines: 1) Knowledge representation and reasoning techniques; 2) Grid technologies; 3) Digital library technology; and 4) Interactive knowledge acquisition techniques.

A central element of this project will be a Knowledge Transfer, Education and Outreach program with four primary goals: 1) to transfer the technology developed under this project to the end users of earthquake information, including engineers, emergency managers, decision makers, and the general public; 2) to cross-educate advanced students in the fields of geoscience and computer-science; 3) to make the general public aware of the benefits of applying advanced information technology to the problems of earthquake risk; and 4) to use public interest in earthquake information to attract beginning students into geoscience and computer science. A specific objective will be to engage young Hispanic Americans in the intellectual challenges of earthquake information technology.

Yes

If Yes, provide award #s

EAR 0122464

<p>Nanoscale Science and Engineering Comments:</p> <p>NANOGEOSCIENCE WORKSHOP</p> <p>Nanoscience and nanotechnology have emerged as major fields in the national research agenda and the Earth science community has clearly identified nanoscience in the environment as an emerging field in which interest has been growing in the past few years. About 50 scientists participated in an <i>Interdisciplinary Workshop on Nanogeoscience</i> sponsored by an NSF grant (\$36,000, EAR – Instrumentation & Facilities, 0226362) to Glenn Waychunas of Lawrence Berkeley National Lab (LBNL). The workshop was convened by Drs. Waychunas and Alexandra Navrotsky at LBNL on June 14-16, 2002 to assess the opportunities and challenges in the field as well as pertinent connections between nanogeoscience and other nanoscience fields. Leaders in the field presented 29 lectures with abundant opportunities for discussion and questions on these topics:</p> <ul style="list-style-type: none"> • Formation and stability of nanoparticles • Nanoclusters in aqueous solution • Nanomineralogy • Nanomaterials and surfaces • Nanoparticle aggregation and transport • Nanoparticles in the environment • Simulation of nanoparticles • Microbe-nanoparticle interaction <p>Representatives from NSF, DOE, NRC and EPA also presented agency perspectives on support opportunities in this developing field. Six working groups with assigned group leader and scribe (usually a graduate student) met for about three hours following the lectures to sketch answers to these questions:</p> <ul style="list-style-type: none"> • What special contributions can geoscience make toward advances in nanoscience? • What unique products does geoscience offer in nanoscience? • In what areas would agency funding significantly advance the field? • What areas are critically underfunded? • What are the important areas for seed funding? • What strategies should be applied to facilitate education? <p>Group leaders met on the last day to organize a summary document which will become a public document to guide future NSF program announcements.</p>	<p>Yes If Yes, provide award #s EAR 0226362</p>
<p>Interdisciplinary mathematics Comments:</p>	<p>Data not available</p>

Provide one or more examples of NSF supported results with award numbers to justify each selection above. For each example, provide a brief narrative to explain the importance of the result in non-technical terms. For each NSF example cited, include the following information:

- NSF Award Number
- PI Names
- PI Institutions
- Relevant Performance Goal/Indicator
- Relevant Area of Emphasis
- Source for Report

Comment on steps that the program should take to improve performance in areas of the IDEAS goal.

B.3.a COV Questions for TOOLS Goal

OUTCOME GOAL for TOOLS: Providing “broadly accessible, state-of-the-art and shared research and education tools.”

Consider each of the six indicators for the TOOLS goal. Has the activity supported projects that demonstrate significant achievement for the TOOLS outcome goal indicators? Provide NSF-supported examples for each of the relevant indicators that apply to the activity and explain why they are important for the TOOLS outcome. If projects do not demonstrate significant achievement, comment on steps that the program should take to improve. Do not discuss if indicator is not relevant to the activity.

TOOLS INDICATORS	<p>PROGRAM ACHIEVEMENT</p> <p>Select one:</p> <p>SIGNIFICANT, NOT SIGNIFICANT, DOES NOT APPLY or DATA NOT AVAILABLE</p>
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	If Significant, provide award #s
	If Significant, provide award #s
Partnerships, e.g., with other federal agencies, national laboratories, or other nations to support and enable development of large facilities and infrastructure projects; Comments: Not Applicable: Addressed by the Instrumentation & Facilities Program (IF) which is covered by a separate COV.	If Significant, provide award #s
Use of the Internet to make SMET information available to the NSF research or education communities; Comments: Not Applicable: Addressed by the Education & Human Resources Program (E&HR) which is covered by a separate COV.	If Significant, provide award #s
Development, management, or utilization of very large data sets and information-bases; Comments: Not applicable; addressed by the Instrumentation & Facilities Program (IF) which is covered by a separate COV.	If Significant, provide award #s
Development of information and policy analyses that contribute to the effective use of science and engineering resources. Comments: Not applicable.	If Significant, provide award #s

Provide one or more examples of NSF supported results with award numbers to justify each selection above. For each example, provide a brief narrative to explain the importance of the result in non-technical terms. For each NSF example cited, include the following information:

- NSF Award Number
- PI Names
- PI Institutions
- Relevant Performance Goal/Indicator
- Relevant Area of Emphasis
- Source for Report

Comment on steps that the program should take to improve performance in areas of the TOOLS goal.

B.3.b COV Questions related to TOOLS Areas of Emphasis

For each relevant area shown below, determine whether the program’s investments and available results demonstrate the likelihood of strong performance in the future? Justify your argument by providing NSF-supported examples of investment results (with grant numbers) that relate to or demonstrate outcomes for the TOOLS goal and relevant indicators in the space below the area of emphasis. If the area of emphasis is not relevant to the activity, do not discuss.

<p style="text-align: center;">TOOLS AREAS OF INVESTMENTS</p>	<p style="text-align: center;">Demonstrates likelihood of strong performance in future? Select one: Yes, No, Does Not Apply or Data Not Available</p>
<p>Major Research Equipment (MRE) Comments: Not addressed by current COV; expect programs to be involved in the future, e.g., EarthScope.</p>	<p style="text-align: center;">If Yes, provide award #s</p>
<p>Major Research Instrumentation (MRI) Program Comments: Not applicable; addressed by the Instrumentation & Facilities Program (IF) which is covered by a separate COV.</p>	<p style="text-align: center;">If Yes, provide award #s</p>
<p>Science & Engineering information, reports, and databases Comments: Not relevant.</p>	<p style="text-align: center;">If Yes, provide award #s</p>
<p>Scientific databases and tools for using them Comments: Not addressed by current COV; expect programs to be involved in the future, e.g., EarthScope, GEON (partly funded by ITR), and others.</p>	<p style="text-align: center;">If Yes, provide award #s</p>

<p>National SMETE Digital Library Comments: Not applicable; addressed by the Education & Human Resources Program (E&HR) which is covered by a separate COV.</p>	<p>If Yes, provide award #s</p>
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Provide one or more examples of NSF supported results with award numbers to justify each selection above. For each example, provide a brief narrative to explain the importance of the result in non-technical terms. For each NSF example cited, include the following information:

- NSF Award Number
- PI Names
- PI Institutions
- Relevant Performance Goal/Indicator
- Relevant Area of Emphasis
- Source for Report

B.4 Please comment on any program areas in need of improvement.

Some programs need to improve documentation of proposal actions. Some programs need to improve feedback to PIs, particularly declines. A clear, informative message to the PI is fair and just feedback. This communication is needed to help PIs direct their efforts toward revision and resubmission, or seeking other avenues of support. Both of these areas (documentation and feedback) may be aided by improvement in the workload issue and by promulgation of “best practices” by EAR division management.

B.5 Provide comments as appropriate on the program’s performance in meeting program-specific goals and objectives, which are not covered by the above questions.

Nearly all Program Officers have proposal review responsibilities that are related to cross-division, cross-directorate and occasionally cross-foundation programs that are part of their workload, but were not evaluated by this COV. It appears that we were not asked to look at the entire spectrum of responsibilities of the EAR programs and thus could not fully answer whether they are meeting program-specific goals and objectives.

B.6 NSF would appreciate your comments for improvement of the COV review process, format and report template.

The size of the Committee is appropriate, the time devoted to the review process is adequate, however the written documentation provided to the committee was uneven with respect to quality of information. A high quality spread sheet of proposal actions should be adopted by

the entire Division and a more consistent way of highlighting program results should be adopted. The report template is surprisingly user friendly.