

**Report of the Committee of Visitors  
Deep Earth Processes Section  
Division of Earth Sciences  
Directorate for Geosciences  
National Science Foundation  
2011-2013 Review Period**

**COV Process**

The 2014 Committee of Visitors (COV) to the Deep Earth Processes (DEP) Section met on August 12-14 2014 at the National Science Foundation. Our charge was to review 2011-2013 proposal actions and program effectiveness in five DEP programs: Continental Dynamics (CD), EarthScope (ES), Geophysics (PH), Petrology and Geochemistry (CH), and Tectonics (TE).

Each program was evaluated by a subcommittee of five COV members, except for CD, which was reviewed by the entire COV (minus the COV chair). The program reviews were based on proposal jackets, presentations by DEP Program Officers (POs), follow-up discussions with POs, DEP program statistics and solicitations, and prior DEP COV reports.

**Findings and Recommendations across DEP**

- DEP programs are funding essential and cutting-edge science, including potentially transformative research and an appropriate blend of inter-disciplinary and disciplinary projects.
- DEP POs are doing an outstanding job of running their programs. The COV was particularly impressed by the excellence of this management in the face of very high PO workloads and flat or declining program budgets.
- The proposal review process in each program is based on expert information from mail, panel and PO evaluations. It is fair, transparent, and in general clearly documented.
- DEP POs have been pro-active in working with their research communities to define and develop new research directions, and they pay close attention to funding trends and concerns (e.g. large observational projects, experimental and analytical labs) and the health of the research workforce.

***Proposal Review***

The COV strongly supports the proposal review process used across all programs that combines mail reviews, panel reviews and PO judgment in making the final funding decisions.

The great majority of mail reviews provided high quality, in-depth evaluations of proposed research from scientists with relevant expertise. The level of insight provided by the mail reviews would be impossible to replicate with only panel review. In 2011-2013, the annual average numbers of mail reviews in DEP programs ranged from 5.5 to 8.0. The range of mail reviewers was typically an excellent match to the proposed project, demonstrating canny selection and tenacity on the part of the POs. Only 60-70% of requested reviews were returned, so a sufficient number of high quality reviews required a great deal of PO effort. Almost all reviews addressed both intellectual merit and broader impacts criteria, although evaluations of broader impacts were typically much briefer. Reviewer definitions of quality in broader impacts varied substantially.

Panel summaries typically reflected in-depth and fair discussion of proposed projects. Panel discussion is essential because it provides synthesis of reviewer comments, a broader perspective, and a consistent evaluation across the proposal pool. Panels also play an important role by educating panelists about the proposal review process and its transparency. This function is particularly important for the early career principal investigators (PIs) who serve on DEP panels for one-year terms. The number of panelists who read proposals varies among programs. For example, 3 panelists read each proposal in CH, 5-6 in PH (3-4 for co-reviewed proposals), and all non-conflicted panelists in ES and CD. Nonetheless, well-reasoned decisions prevailed in all programs. DEP programs have moved to a practice of jointly convening to discuss co-reviewed proposals, deepening panel analysis and removing the threat of “double jeopardy.”

The level of PO insight and care in reaching final funding decisions was in general outstanding. Panel evaluations, supported by mail reviews, were clearly a primary consideration in PO decisions. However, POs also considered a variety of factors in reaching decisions, including the impact of funding on PI careers, programmatic balance, and workforce diversity. We concur that these factors were weighed appropriately. The rationales for funding decisions were typically documented in PO review analyses, and were often, but not always, clearly communicated to PIs. A few exceptions in CD and ES are described in the subcommittee reports for these programs.

*Recommendation 1:* The exemplary three-part review process employed in DEP (mail reviews, panels and PO analyses) should be continued, and enough PO and support staff positions should be allocated to make this process sustainable.

*Recommendation 2:* The PO review analyses were a revelation and gave us great insight into funding decisions. The depth of thought and information in these review analyses is a very valuable resource for PIs. Some POs shared significant portions of their review analyses (redacted to remove confidential information) with PIs, but this practice was not uniform. We recommend more consistently providing PIs with the content of PO review analyses.

*Recommendation 3:* We recommend that POs continue their efforts to educate reviewers, panels and PIs about broader impacts. The range of activities required for high quality broader impacts apparently remains a source of confusion, as was also noted by the past

two COV reports. Further clarifying this issue would aid PIs who otherwise may face moving targets of expectation when they submit proposals to different programs. In particular, top-notch work in graduate and/or undergraduate education is one path to excellence in broader impacts. Other types of activities (e.g. K-12 education, public outreach, media work) are also valuable broader impacts, but should not be viewed as necessary to achieving a high ranking.

### ***Program Planning and Management***

DEP POs manage their programs with great skill, insight and commitment. These traits have become even more essential due to limited program funding and the demands on PO time from programs and initiatives outside of core DEP programs. Over the review period, budgets in all programs except CD were flat in 2011-2012, and decreased in 2013. The CD budget increased in 2012, but no new proposals were accepted in 2013 because the program was being phased out.

DEP POs are very active in seeking co-funding for proposals, including co-funding from programs outside of EAR and GEO. This work is essential in light of constrained program budgets, and in some programs added funding equal to 15%-25% of the program budget for a given year; it also supports trans-disciplinary science.

The DEP POs carefully consider the scope of the research funded by their programs, how it reflects and enhances trends in their disciplines, and its potential for breakthroughs and transformative science. The COV concurs with the prevailing DEP philosophy of allowing the PI community to define program directions, while enhancing this process through workshops and community-based science initiatives (e.g. CIDER, CIG, COMPRES, and DEFORM). One aspect of this philosophy is to maintain broad definitions for the research funded by the PH, CH and TE programs, so that these programs can be responsive to emerging trends. The ES and CD programs by their nature have more focused definitions. Some program solicitations were revised over the review period, and others are in the process of revision. Program names were also reconsidered, and the decision was made to maintain existing program names. This process has addressed several recommendations of the 2008-2010 COV, and the current COV considers its outcome to be appropriate.

DEP POs identified two funding trends that are of particular concern.

First, large observational projects with budgets of ~\$1M are becoming increasingly difficult to fund given flat or declining program budgets. This problem is particularly acute for projects involving geophysical data collection, where data acquisition costs tend to be higher and cutting-edge methods are pushing for larger sensor arrays. The problem has become more acute with the termination of the CD program, a longstanding home for large observational projects in DEP, and the planned end of ES in 2018 heightens concern. Maintaining capabilities for large data acquisition campaigns is a critical need for DEP science, and indeed for all of the Geosciences Directorate.

Second, the current funding climate has compromised continuous support for many labs with experimental and analytical instrumentation. Gaps in funding take a particularly heavy toll on the technical personnel who play an essential role in many of these labs. Once lost to a lab, the expertise provided by technical personnel can be very difficult to replace. The long-term consequence of this trend will be a decline in U.S. capabilities for experimental and analytical science.

*Recommendation 4:* DEP should continue to seek solutions for funding large observational projects and for sustaining experimental and analytical labs and the expert personnel they require. Increasing funding to DEP programs is one obvious solution that should be actively pursued, but coordinated strategies and new support models in DEP and across EAR should also be explored. For example, CH has been investigating joint planning with the EAR Instrumentation and Facilities program.

### ***The DEP Workforce***

In 2011-2013, the percentages of “new PIs” (PIs without prior NSF support) among all PIs submitting proposals to the four ongoing DEP programs (PH, TE, CH and ES) ranged from 16% to 24%. The COV viewed this level of new PI participation as healthy. The percent of new PIs in the CD program (2011-2012) was lower (6%), but this result is unsurprising given the large, multi-disciplinary nature of CD projects. The percentages of new PIs who received funding were lower than the funded percentage of all PIs (Table 1). Given the relative lack of experience that new PIs have with the NSF proposal process, this result is not cause for concern. DEP POs typically take great care to provide new PIs with helpful feedback. One program, PH, has also measured the percentages of success among early career PIs (<10 years post-PhD). These PIs are funded at a percentage closer to the overall PI pool.

Table 1. Percentages of PIs who were funded (2011-2013)

	All PIs	New PIs	Female PIs	Minority PIs
CH	54%	41%	57%	46%
CD	34%	14%	32%	60%
ES	40%	15%	37%	14%
PH	57%	41%	58%	44%
TE	44%	34%	46%	36%

The percentages of women in the PI pool for each DEP program ranged from 18-23% in 2011-2013. These figures are comparable to the percentage of women among AGU members in 2010 (20%) (Holmes et al., EOS, 2011). The percentages of women who received funding is roughly equal to the successful percentages of all PIs (Table 1). By these measures, women appear to be participating and achieving success in DEP programs at levels equivalent to their representation in the field and the PI pool, respectively.

Underrepresented minority PIs make up 3-4% of the PIs who submit proposals to DEP programs. However, these percentages rely on self-reporting, and anecdotal information suggests that minority PIs are undercounted. Of the identified minority PIs, the percentages who obtained funding are lower than the funded percentages among all PIs in CH, PH and TE, while higher in CD (Table 1). Because these statistics are based on small numbers, we aggregated PI numbers across all programs to get a more robust measure. For all DEP programs in 2011-2013, the percentage of funded PIs among all PIs is 48%, and the percentage of funded PIs among minority PIs is 40% (17 out of 43). We note that the aggregated numbers of minority PIs are still fairly small. For example, if 3-4 more minority PIs were funded, the funded percentage would equal that in the total PI pool. Nonetheless, this gap in proposal success should be more closely examined.

*Recommendation 5:* DEP programs should develop strategies to more accurately measure participation of minority PIs and their success with funding relative to the total pool of PIs. Should a gap in success still be apparent, its causes should be studied and addressed. DEP programs should also continue their wider efforts to enhance diversity in the research community, including attention to this issue in proposal broader impacts.

### ***CAREER Proposals***

DEP POs are very supportive of early PIs, through standard proposals and CAREER awards. DEP programs (with the exception of CD and ES) have seen a steady rise in the number of CAREER proposals submitted and awarded, continuing the trend noted by the previous COV. We strongly support and encourage this allocation of resources as a means of building future leadership in the DEP research community. The feedback offered by POs to unfunded PIs was excellent and undoubtedly resulted in better resubmissions. During 2011-2013, 53 CAREER proposals were submitted and 29 were funded. The balance between CAREER awards to men versus women roughly reflects submission statistics; 37% of PIs were women, and 35% of awards went to women. We were disappointed to see repeated comments in the mail reviews suggesting that CAREER projects, in particular their educational components, were not a valuable use of either a young faculty member's time or NSF funding. The program officers have done a very good job in promoting submission of CAREER proposals, and continuing these efforts should gradually eliminate the minor stigma surrounding these awards among some in the community. While panels appeared to be supportive of CAREER proposals, it was obviously challenging to evaluate the broader impacts of most projects, especially given the widely varying educational applications. Finally, while several programs clearly work hard to foster CAREER grants, the COV was perplexed by the apparent disparity in handling of CAREER awards between DEP programs. For example, highly rated proposals were not awarded in some programs, while lower-rated proposals were awarded in others.

*Recommendation 6:* Because education and outreach are a major component of CAREER proposals, we recommend that program officers solicit at least one mail review from a geoscience researcher with deeper than usual expertise in education. CAREER proposers

should also be encouraged to seek pre-submission advice from experts in geoscience education.

*Recommendation 7:* To eliminate uneven treatment of CAREER proposals, and to encourage sharing of best practices between programs, we recommend that DEP POs jointly develop criteria for funding CAREER proposals. If timing permits, jointly examining all CAREER proposals following panel meetings should also be considered.

### ***NSF-wide Issues***

DEP POs have taken on leadership roles in programs and initiatives outside of core DEP programs, and these responsibilities are very time-consuming. These activities also bring back benefits to DEP, sometimes including co-funding, but nonetheless make it more challenging to manage DEP programs.

*Recommendation 8:* Before committing to any new initiative within NSF, an assessment should be made of the person-hours it requires and the demands that are likely to be made on PO efforts to run their core programs. When a PO's time is allocated to a new initiative, new PO positions should be added to help manage the PO's prior programs.

Many NSF information systems are antiquated and make it more difficult for POs to find reviewers, identify conflicts of interest, and otherwise manage the review process and awards.

*Recommendation 9:* Improved information systems should be aggressively pursued. Great potential exists to save time spent on routine tasks, thus better enabling POs to manage their extensive responsibilities within and beyond their home programs.

### ***DEP Response to the 2008-2010 COV Report***

DEP programs have addressed the recommendations of the 2008-2010 COV report. DEP POs have continued their efforts to educate PIs, reviewers and panels about broader impacts. Re-naming of DEP program names was considered, program scopes and solicitations were reviewed, and some solicitations were revised. A decision was made to not provide the 2011-2013 COV with access to jackets prior to meeting at NSF, but this did not hamper our work. Recommendations of the 2008-2010 COV specific to individual DEP programs are addressed in the reports of the program subcommittees.

### ***The Impact of DEP Science***

The research funded by DEP programs is essential to U.S. science on several levels.

Although the internal thermochemical structure, dynamics and evolution of our planet have been coming into better focus, fundamental questions remain, many of which are described in *New Research Opportunities in the Earth Sciences* (National Research Council, 2012). Research in DEP programs is at the forefront of answering these

questions, and new methods are rapidly evolving, combining cutting edge observational arrays, laboratory experiments, analytical studies, and computation-intensive modeling.

In addition to being fascinating from a basic science perspective, DEP research has key implications for a range of national priorities. Here we name just a few. Through advances in understanding earthquakes, tsunamis, landslides and volcanic eruptions, DEP science informs mitigation of natural hazards. For example, the recent revolution in illuminating the full spectrum of fault slip behavior (e.g. slow slip events, low frequency earthquakes), and innovative modeling of the slip and rupture histories of recent great earthquakes, are causing a fundamental re-evaluation of fault behavior and hazard potential. Volcanism and tectonics are inextricable components of the climate system, and understanding these interactions is key to modeling climate change. Increasing sophistication in modeling seismic wave propagation through better-resolved Earth structure is improving nuclear weapons monitoring. Pioneering research in Earth material properties and dynamics at high pressure supported by DEP is advancing knowledge about superhard, superconductive and composite materials with a myriad of technological applications.

Students and post-docs supported by DEP funding go on to a wide variety of careers. These include academia (where they contribute to the education the U.S. workforce), the exploration industry, the U.S. Geological Survey, and numerous other government agencies (where they contribute to better use of natural resources and mitigation of natural hazards).

*Recommendation 10:* We recommend that DEP program budgets grow. Improved funding will prevent loss of U.S. capabilities in observational, experimental and analytical science, enable transformative research, address key national priorities, and develop the careers of the next generation of the geoscience workforce.

**FY 2014 REPORT TEMPLATE FOR  
NSF COMMITTEES OF VISITORS (COVs)**

The table below should be completed by program staff.

<b>Date of COV: August 12-14, 2014</b>
<b>Program/Cluster/Section: Deep Earth Processes</b>
<b>Division: Earth Sciences</b>
<b>Directorate: Geosciences</b>
<b>Number of actions reviewed: 181 proposals (97 projects)</b>  <b>Awards: 60 proposals (37.5 projects)</b>  <b>Declinations: 121 proposals (59.5 projects)</b>  <b>Other:</b>
<b>Total number of actions within Program/Cluster/Division during period under review: 2831</b>  <b>Awards: 720 proposals</b>  <b>Declinations: 1385 proposals</b>  <b>Other: 726 proposals</b>
<b>Manner in which reviewed actions were selected:</b>  <b>Reviewed proposals were selected from Fall 2012 proposals for the Tectonics, Geophysics, EarthScope and Petrology and Geochemistry programs, and from 2011 proposals for Continental Dynamics. Proposal selection strategies are described in more detail in the individual program subcommittee reports.</b>



### COV Membership

	Name	Affiliation
<b>COV Chair or Co-Chairs:</b>	<b>Dr. Karen M. Fischer</b>	<b>Brown University</b>
<b>COV Members:</b>	<b>Dr. Steven M. Day</b> <b>Dr. James P. Evans</b> <b>Dr. Anke M. Friedrich</b> <b>Dr. Edward J. Garnero</b> <b>Dr. Peter J. Hudleston</b> <b>Dr. Mary L. Leech</b> <b>Dr. Charles E. Leshner</b> <b>Dr. Carolina R. Lithgow-Bertelloni</b> <b>Dr. Calvin F. Miller</b> <b>Dr. Michael P. Poland</b>	<b>San Diego State University</b> <b>Utah State University</b> <b>Ludwig Maximilian University of Munich</b> <b>Arizona State University</b> <b>University of Minnesota, Twin Cities</b> <b>San Francisco State University</b> <b>University of California, Davis</b> <b>University College London</b>  <b>Vanderbilt University</b> <b>Hawaiian Volcano Observatory, USGS</b>

## 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(s) under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

### Tectonics (TE)

The Tectonics (TE) subcommittee consisted of Peter Hudleston (chair), James Evans, Anke Friedrich, Mary Leech, and Calvin Miller, who shared reading of TE proposal jackets. NSF made available proposal jackets for the Fall 2012 panel review. This panel handled 86 proposals, of which 80 proposals were submitted to TE and 6 were handled jointly with other programs (Geophysics, Petrology and Geochemistry, EarthScope, and Geomorphology and Land Use Dynamics). Three additional proposals were jointly reviewed by TE and another program, but jackets for these were not directly available and were not asked for. Of the 86 proposals, we selected 20 unique jackets/projects, including all four CAREER proposals for which TE was the lead program. The selection also included the highest and the lowest ranked proposals in each category (“fund”, “fund if possible”, and “do not fund”), and all (ten) proposals with disagreements in the ranking among the ad hoc (mail) reviews, the panel, and/or the final decision by the POs. Of these ten, in five cases the final decision of the PO did not follow the unanimous recommendation of the mail-in reviews and the panel; one collaborative research proposal was chosen where the lead proposal was funded, but the associated proposal was declined; five proposals were chosen based on discrepancies between the mail review and the panel ranking.

**I. Questions about the quality and effectiveness of the program’s use of merit review process.** Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT
<p><b>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</b></p> <p>The combined use of ad hoc mail reviews and panel review provides an impressively thorough and fair review of proposals. This provides a sound base of information to the POs for making their decisions. This works so well because of the attention give by POs to the choice of ad hoc reviewers and panel members.</p> <p>The average number of reviews per proposal ranged from 5.8 to 6.1 over 2011-2013 (a 60% - 65% return rate). 8-9 panelists (with 1-2 early career) discussed 85%-95% of the proposals.</p>	<p>Yes</p>

<p><b>2. Are both merit review criteria addressed</b></p> <p><b>a) In individual reviews?</b> The collective attention given in the individual mail reviews to merit based on intellectual content and impact was thorough in all the jackets sampled, giving substance to the reviewers' numerical ratings. In a very few cases the reviews were brief and unhelpful. The evaluation of broader impacts was addressed in virtually all individual reviews for each proposal. The interpretation of the meaning of "broader impacts," however, was not consistent; for example some reviewers interpreted broader impact as simply being contribution to the scientific discipline. Discussion of broader impacts was usually relatively brief.</p> <p><b>b) In panel summaries?</b> Panel summaries provided uniformly clear, accurate and reflective summaries of the mail reviews. They also provided succinct summaries and reviews of the broader impacts. Panels were not asked to review the lowest ranked proposals based on individual reviews, and thus did not provide summaries for these.</p> <p><b>c) In Program Officer review analyses?</b> PO summaries and analyses of the individual reviews and of the panel were uniformly comprehensive, addressing well both intellectual merit and broader impacts.</p>	<p>Yes</p> <p>Yes</p> <p>Yes</p>
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<p><b>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</b></p> <p>Yes, almost invariably (but, as expected, the substance can vary widely/wildly from reviewer to reviewer). They also provided succinct summaries and reviews of the broader impacts. The tone of most of the external reviews was consistently professional and helpful. We estimated that over 80% of the external reviews examined were detailed - meaning there were several detailed paragraphs devoted to intellectual merit, and questions being asked, methods, research schedules, etc., were all addressed in a fair and well-reasoned manner. The previous COV expressed concern about the uneven quality of the ad hoc reviews. While a few of the reviews in the pool we examined lacked useful content, most were thorough, and in every jacket there were sufficient substantive reviews to provide useful guidance to the panel and the POs.</p>	<p>Yes</p>
<p><b>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</b></p> <p>The panel summaries generally provided succinct and accurate summaries of the mail reviews and clear statements of and reasons for any disagreement with the mail reviews. They also provided additional perspectives to the mail reviews, reflecting the valuable expertise of the panel members. In a few cases, the panel summaries were somewhat perfunctory and not very informative. Panel summaries were appropriately guarded, given that they are not intended to imply a decision. The panel was not asked to review a number of very low-ranked proposals (based on individual reviews and POs' discretion) and thus panel summaries were not provided for these.</p>	<p>Yes</p>

<p><b>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</b></p> <p>The review summaries and analyses provided by the POs were very thorough and informative, and they provide a clear rationale for the decisions made. This is especially true in cases where the PO had gone against the ranking of the reviewers and/or the panel. Reasons for this included whether the PI was early career and/or at a vulnerable point in their career, whether or not the PI had other NSF support, and the involvement of underrepresented minorities in the research. Overall, the PO summaries reflected a strong concern for fairness and openness with the PIs, especially in cases that were difficult to decide. The documentation provided in the jackets indicates that the POs provide good context for the entire flow of the proposal under consideration, and the context of the work is well stated.</p>	<p>Yes</p>
<p><b>6. Does the documentation to the PI provide the rationale for the award/decline decision?</b></p> <p>Although the rationales for the decisions were clear in the jackets, in a very few cases the reasons for declining a proposal may have been frustratingly fuzzy to proposers. In these cases, including more material from the PO review analysis – without compromising the anonymity of reviewers and panelists – would rectify this issue. We recommend that this be done.</p>	<p>Yes</p>
<p><b>7. Additional comments on the quality and effectiveness of the program’s use of merit review process:</b></p> <p>The number of individual reviews averaged just under 6 for the period under review, and this did not change much from year to year. For the 20 jackets selected for individual review, the minimum number of reviews returned was 3, and maximum 7.</p> <p>Most people (ad hoc reviewers, panelists and POs) involved in the review process addressed both intellectual merit and broader impacts criteria, with varying degrees of intensity. As has historically been the case, most reviewers and the panel focused on the research aspects of proposals, but broader impacts were addressed at all levels, and it is our impression that broader impacts were addressed more thoroughly than in previous COV reviews.</p> <p>Overall, the merit review process, refined over time, is of very high quality and provides a comprehensive and fair review of all proposals submitted to the program.</p>	

**II. Questions concerning the selection of reviewers.** Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

SELECTION OF REVIEWERS	YES , NO,
<p><b>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</b></p> <p>The program officers are to be commended for consistently identifying reviewers with substantial knowledge and expertise in the subject matter of each proposal. The level of detail and insight provided by the reviews attest to this. This is an outstanding element of the review process.</p>	Yes
<p><b>2. Did the program recognize and resolve conflicts of interest when appropriate?</b></p> <p>This was not always easy to tell, but where where COIs were revealed, they were treated effectively by the POs.</p>	Yes
<p><b>Additional comments on reviewer selection:</b></p> <p>The POs obviously work hard at finding appropriate reviewers, and coordinate with POs in other programs in an effort not to overburden individual reviewers with requests. They continually work to identify new reviewers to add to the “pool.” The number of reviews per project requested (7-9) and the return rate of 60-65%, which were fairly constant over the review period, ensured that each proposal had sufficient ad hoc reviews from experts in the field of the proposal.</p>	

**III. Questions concerning the management of the program under review.** Please comment on the following:

<b>MANAGEMENT OF THE PROGRAM UNDER REVIEW</b>	
<p><b>1. Management of the program.</b></p> <p>During the period of review, the Tectonics (TE) program had two full-time POs, David Fountain and Steven Harlan. These two individuals have managed a remarkably efficient and healthy program that supports research across all areas of tectonics. This research area, by its nature, is highly interdisciplinary, and this results in the program receiving proposals from PIs and co-PIs with a wide range of disciplinary backgrounds. The program supports many collaborative projects involving several PIs from within a single institution or across two or more institutions. The dedication the POs give to their task is a large reason for the success of the program. Particularly challenging during the period of review, both POs had heavy responsibilities directing other programs; despite this there was no evidence in TE for loss of “momentum” in the work of reviewing proposals and managing the program.</p> <p>Overall, the program is very well managed, especially considering the demands on the POs’ time beyond managing the TE program. The review process is handled very effectively, as discussed in Parts I and II. The POs communicate closely with their colleagues in other programs within EAR and GEO, and seek out opportunities for supplemental funding from other sources within EAR, GEO and more broadly within NSF, such as International Activities and EPSCoR. In 2011-2013, co-funding from outside of EAR was equal to ~17% of the TE budget. POs also collaborate with their colleagues outside TE in identifying potential reviewers and in making sure individual reviewers are not overburdened with requests. More detail is covered in questions 2-4 below.</p>	
<p><b>2. Responsiveness of the program to emerging research and education opportunities.</b></p> <p>The POs work at having the pulse of the community by attending, as they can, key scientific meetings. They indicated that the ability to respond to emerging research opportunities is highly valued, and has led them to maintain breadth in the program solicitation. They work to identify trends within submitted proposals (e.g. linkages between deep processes and surface uplift, application of novel geochronology/thermochronology, incipient plate boundaries, and more).</p> <p>POs also assess emerging research directions through community workshops. TE has increased support for workshops overall (6 were funded in 2011-2013), and workshops focused on new directions are being planned. DEFORM, focused on the needs of the rock deformation community, is in development with PH and Instrumentation and Facilities. TE is also working with EarthCube on digital tools for rock deformation and structural geology.</p> <p>Work is underway on a new program solicitation that will more clearly define program goals and scope, while remaining broad enough to be open to unforeseen trends. A “Tectonics Collaboratories” track is being added to catalyze new research directions.</p>	

**3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.**

Through reading proposals, attending scientific meetings and workshops, and communicating with colleagues in other EAR and GEO programs, the POs are knowledgeable about developments in the field, and encourage proposals that take advantage of these developments. This is addressed further under the next question.

**4. Responsiveness of program to previous COV comments and recommendations.**

In addition to the DEP-wide recommendations, the 2008-2011 COV provided recommendations specific to the TE program. The prior COV recommended that TE POs enhance their work with the tectonics community to define emerging research trends. Funding workshops and increasing communication between POs and the tectonics community were suggested.

TE POs have responded to these suggestions, and to DEP-wide recommendations, by increasing the number of funded workshops, developing a new program solicitation, and developing community initiatives (e.g. DEFORM) and resources (collaboration with EarthCube on digital tools). See question III.2. The new program solicitation will more clearly define program goals and scope. For example, it will make clear that multi-PI interdisciplinary awards are not favored over single-PI projects.

To address comments from the prior COV related to Broader Impacts, TE has enhanced feedback to PIs in PO comments and has improved panel training.

**IV. Questions about Portfolio.** Please answer the following about the portfolio of awards made by the program under review.

<b>RESULTING PORTFOLIO OF AWARDS</b>	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p><b>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</b></p> <p>The balance is appropriate, to the extent we can judge by the set of proposals for which we were provided access. These proposals reflect the research efforts of the community across a broad range of activities. Much current research in tectonics is collaborative and interdisciplinary, and this is reflected both in the types of proposals submitted and in the awards made. At the same time, an appropriate number of individual investigator proposals are funded. In short, the overall portfolio is well balanced.</p>	Appropriate
<p><b>2. Are awards appropriate in size and duration for the scope of the projects?</b></p> <p>Yes, from the set of funded proposals (10 proposals, 5 projects) we reviewed. The typical award is about \$100,000 per year. Our impression overall is that the POs do an excellent job of setting budgets within the constraints of the overall program budget (and reviewers, panels, and POs provide good recommendations to PIs where proposals are overly ambitious).</p>	Appropriate
<p><b>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</b></p> <p>Few proposals of those selected for individual review could be described as transformative, but several were highly innovative in the tools or approaches proposed and have the potential to affect how others conduct their research.</p>	Yes



<p><b>4. Does the program portfolio include inter- and multi-disciplinary projects?</b></p> <p>Tectonics by its nature involves cross-disciplinary work. The program portfolio includes numerous examples of inter-disciplinary projects, with 12 of 84 proposals being considered by the Fall 2012 TE panel also considered by other programs within GEO. Many of the other projects evaluated in this round involve single proposals from PIs in different sub-disciplines within a department or proposals from individuals in different disciplines at different institutions. Fewer proposals involved disciplines outside of those in DEP programs.</p> <p>The level of co-funding from other programs within EAR and from other directorates within NSF is another measure of the amount of inter-disciplinary and multi-disciplinary research supported by TE. This funding totaled a little more than \$1.6 million in 2012, and nearly \$4.7 million in the 3-year period under review. As is appropriate, TE supports other programs within the directorate, to the benefit of all programs.</p>	<p>Yes</p>
<p><b>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</b></p> <p>During 2011-2013, the geographical distribution of funded proposals was highly uneven, with many awards in California and Texas, and 6-10 awards in a smattering of other states. This distribution did not simply reflect the proposal pool, in the sense that funding rates varied widely by state (for example 40% in NY, 39% in MA, 30% in CA, 25% in TX, and 16% in FL). However, it may reflect the concentration of PhD-granting institutions. In any case, the geographical distribution of awards was not seen as a cause for concern.</p>	<p>Appropriate</p>
<p><b>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</b></p> <p>Over 80% of 2011-2013 TE awards went to PhD-granting institutions, and more than 65% of awards went to the top 100 research institutions. However, TE awards were less dominated by the top 100 than were other DEP programs. This balance is a strength.</p>	<p>Appropriate</p>

<p><b>7. Does the program portfolio have an appropriate balance of awards to new investigators?</b></p> <p>New PIs were responsible for about 25% of the proposals submitted in the period under review, and received about 20% of the awards. These numbers are both somewhat higher than in DEP as a whole. The percentage of new TE PIs funded (34.1%) is lower than the percentage of all PIs funded (43.5%). The lower success rate of new PIs compared to all PIs is to be expected, given the limited experience of new PIs. The number of new co-PIs (new involvement) funded (37) is somewhat higher than the number of new PIs funded (28) and the success rates of new PIs and new co-PIs are similar. Overall, the numbers of new PIs and co-PIs submitting proposals to TE, and the success rate of these proposals, is healthy and encouraging for the future of the program.</p>	<p>Appropriate</p>
<p><b>8. Does the program portfolio include projects that integrate research and education?</b></p> <p>Essentially all do to some extent – in that nearly all involve training of graduate students or undergraduates in research, which is of fundamental importance to the success and health of the program. In most cases the integration (beyond training of students) is not given much attention in the proposals. A few projects engage in educational outreach in creative ways.</p>	<p>Yes</p>
<p><b>9. Does the program portfolio have appropriate participation of underrepresented groups<sup>2</sup>?</b></p> <p>Women were 20% of the PIs submitting proposals to TE in 2011-2013. These numbers are similar to those for the other programs in DEP. The percentage of women PIs funded (46%) is slightly higher than the percentage of all PIs funded (44%); the percentage of women co-PIs funded (44%) is equal to the percentage of all PIs funded.</p> <p>Minorities were 3% of the PI pool in 2011-2013. The percentage of minority PIs funded (36%) is lower than the percentage of all PIs funded (44%), as is the percentage of minority co-PIs funded (29%).</p> <p>Women are appropriately funded at percentages roughly equal to rates of the entire proposal pool. Minorities are funded at lower percentages than the entire proposal pool, but the numbers are small, and the percentages here suffer from the problem of small number statistics. Continuing efforts clearly need to be made to encourage minority engagement in science, and well-crafted proposals should be encouraged from minority PIs with expertise in tectonics. This issue is discussed further in the <i>DEP Workforce</i> section of the DEP overview.</p>	<p>Appropriate for women.</p> <p>Unclear for underrepresented minorities.</p>

<sup>2</sup> NSF does not have the legal authority to require principal investigators or reviewers to provide demographic data. Since provision of such data is voluntary, the demographic data available are incomplete. This may make it difficult to answer this question for small programs. However, experience suggests that even with the limited data available, COVs are able to provide a meaningful response to this question for most programs.

<p><b>10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.</b></p> <p>Tectonics is a highly collaborative and integrative branch of geoscience, and it plays a key role in addressing the goals and priorities of research in the Earth sciences as documented in a number of reports. These include the 2012 report to NSF of the National Research Council, <i>New Research Opportunities in the Earth Sciences</i>. This report emphasizes, like the earlier 2001 report, <i>Basic Research Opportunities in the Earth Sciences</i>, how basic research in the Earth sciences addresses a number of national imperatives. Research carried out under the aegis of TE contributes to at least two of these: discovery, use, and conservation of natural resources; and characterization and mitigation of natural hazards. Tectonics is also closely allied to and in part incorporates related fields of geophysics, and its importance is well documented in the 2009 report submitted to NSF “<i>Seismological Grand Challenges in Understanding Earth’s Dynamic Systems</i>,” and in the 2012 report: “<i>A Foundation for Innovation: Grand Challenges in Geodesy</i>,” supported by NSF, the USGS and NASA. The TE program supports research that addresses goals and opportunities described in all these reports.</p> <p>Also see <i>The Impact of DEP Science</i>, the last section in the DEP overview.</p>	<p>Yes</p>
<p><b>11. Additional comments on the quality of the projects or the balance of the portfolio:</b></p> <p>The quality of the projects submitted in proposals to TE is high, with 47 of the 63 projects submitted for FY2012 deemed worthy of funding, based on the evaluation of the ad hoc and panel reviews. Funding was available to support only 18 of these, an indication of the quality of the research supported.</p>	

## Geophysics (PH)

The Geophysics (PH) subcommittee of the COV consisted of Carolina Lithgow-Bertelloni (chair), Steven Day, Ed Garnero, Charles Leshner, and Michael Poland. The subcommittee examined proposals from the Fall 2012 panel. Of the proposals for which PH was the lead program, the subcommittee selected 25 unique jackets/projects for close reading and review, including 9 CAREER proposals. Each jacket was read by two subcommittee members. The jackets represented a few highly rated projects, the lowest-ranked proposals that were funded, the highest-ranked proposals that were not funded, proposals with discrepancies between mail and panel reviews, and proposals with no panel discussion due to conflicts of interest.

**I. Questions about the quality and effectiveness of the program's use of merit review process.** Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

<b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b>	<b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b>
<p><b>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</b></p> <p>The combination of mail reviews from experts in the area of the proposed work, with context from experts in related areas, plus objective panel reviews and assessment by POs, is essential. It is the best way to ensure quality, fairness and resolution of conflicts and to provide avenues for funding diverse and innovative science. This system provides checks and balances, but also mechanisms for avoiding conservatism and funding high risk/high reward projects.</p> <p>The average number of reviews per proposal ranged from 5.5 to 5.9 over 2011-2013 (a 60% - 65% return rate). Panelists included early career researchers; ~65% of the proposals were discussed.</p>	Yes
<p><b>2. Are both merit review criteria addressed</b></p> <p><b>a) In individual reviews?</b></p> <p><b>b) In panel summaries?</b></p> <p><b>c) In Program Officer review analyses?</b></p> <p>Some reviewers still do not understand the meaning of broader impacts, and sometimes panelists seem unclear as well. The very knowledgeable and fair POs compensate for this deficit in award decisions. POs have gone to great lengths to educate reviewers and panels about broader impacts, and have provided them with specific broader impacts guidelines. This commendable effort should be continued.</p>	<p>Yes, though variable</p> <p>Yes</p> <p>Yes</p>

<p><b>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</b></p> <p>In the proposal jackets examined, reviews were substantive with few (very few) notable exceptions. In these cases, the substandard reviews were balanced for a given proposal by several high quality reviews. This demonstrates careful selection of reviewers by the POs, based on their knowledge of the community.</p>	<p>Yes</p>
<p><b>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</b></p> <p>Most panel summaries provide a clear basis for the panel consensus. Only a few were lacking in this area.</p>	<p>Yes</p>
<p><b>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</b></p> <p>Documentation of the basis for the funding decision is excellent. The COV was particularly impressed by the review analyses of all PH POs, including those who are rotators. The review analyses effectively summarized reviews, the proposal, and decisions, and they justified the decisions in every case. Decisions weighted panel consensus and reviews heavily, but also took other factors into account, when necessary (e.g. career stage, total PI funding, demographics, etc.). POs have an overarching view of the program that is needed and that the panel sometimes may lack. PO efforts are outstanding given the range of disciplines, number of proposals and time pressures that they juggle. POs go out of their way to fund the science that should be funded.</p>	<p>Yes</p>

<p><b>6. Does the documentation to the PI provide the rationale for the award/decline decision?</b></p> <p>Reviews, panel summaries and PO comments to the PI are thorough in every case. In particular, PO comments provide adequate justification for the decision, along with feedback needed for resubmission. This is especially true in the case of CAREER proposals and with early career PIs.</p>	<p>Yes</p>
<p><b>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</b></p> <p>The three-step review process is powerful, as is PO knowledge of the community and its expertise. The latter enables them to bring in top-notch reviews (along with their powers of persuasion) and to select expert, broad-thinking and fair-minded panelists. POs are also able to steer the panel in the right direction if discussions go off course, as reflected in the review analyses, which are exceptionally thorough and well-reasoned.</p>	

**II. Questions concerning the selection of reviewers.** Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

SELECTION OF REVIEWERS	YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p><b>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</b></p> <p>Reviewer expertise is an excellent match to the proposals, almost without fail. Reviewers are an impressive group. The subcommittee found one case where the comments of an expert reviewer were ignored by the panel, although this had no effect on the outcome.</p>	Yes
<p><b>2. Did the program recognize and resolve conflicts of interest when appropriate?</b></p> <p>POs thoroughly dealt with potential conflicts by not releasing reviews that were conflicted, having panelists leave the room when necessary, and not having panelists participate in a panel when they had a proposal in that round. Possible conflicts and their resolution were clearly documented.</p>	Yes
<p><b>Additional comments on reviewer selection:</b></p> <p>Reviewer selection is excellent. POs make good use of their high level of engagement with the community, as well as their own backgrounds and expertise, to select reviewers (including international reviewers) who span the disciplines of the proposal being evaluated.</p>	

**III. Questions concerning the management of the program under review.** Please comment on the following:

<b>MANAGEMENT OF THE PROGRAM UNDER REVIEW</b>	
<p><b>1. Management of the program.</b></p> <p>In 2011-2013, the PH program was managed by Robin Reichlin (PO since 1995), Eva Zanzerkia, Benjamin Phillips (2011), Raffaella Montelli (2012-2013), and Zheng-kang Shen (2013).</p> <p>Program management has been excellent. Not only are award decisions based on top-notch evaluation of the science, they also are humane, i.e. when necessary they take into account the overall health and needs of the PI community (e.g. early career, tenure, soft money, etc.). The POs have provided means for getting excellent science done in the face of a difficult funding climate. POs have an excellent overarching view of the whole program, write outstanding review analyses, provide helpful feedback to PIs, select expert reviewers and panelists, and stay highly engaged with the community through conferences, workshops, and the development of community science initiatives. They set a high standard of professionalism. Honestly, we cannot praise them enough!</p>	
<p><b>2. Responsiveness of the program to emerging research and education opportunities.</b></p> <p>PH is a broad, large and nimble program. It is capable of responding to emerging trends because the POs work closely with the PI community (interacting through meetings, white papers, as well as the proposal process). POs work hard to support the best emerging science directions and address research concerns, through regular proposals but also as reflected in the numerous PH EAGER/RAPID and workshop awards (15 and 20, respectively). POs are also very pro-active about seeking co-funding for PH proposals. For example, in 2011 and 2012, co-funding from outside of EAR was equal to 22%-28% of the PH budget. The most experienced PO has done a fabulous job of cultivating these characteristics in the next generation of POs. PH has also been very successful in increasing CAREER proposal submissions and funding (14 awards). CAREER awards contribute to leadership building and should pay off for the community in the future (i.e. potential National Science Board members, high level medalists, etc.). These efforts speak to a long view of the PH program and DEP science.</p>	



<p><b>3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.</b></p> <p>Given their well-established community engagement, knowledge of community needs, and expertise with NSF and its initiatives, PH POs are very well-equipped to plan and prioritize. Examples include DEFORM (a new rock mechanics initiative), CIDER, CIG, MYRES, and the transformation of CHiPr to COMPRES. The most senior PO transformed the mineral physics community with her proactive planning and prioritization.</p>	
<p><b>4. Responsiveness of program to previous COV comments and recommendations.</b></p> <p>The prior COV expressed concern that PH POs had heavy commitments to programs and initiatives outside of their core responsibilities. PO workloads remained high in 2011-2013, although this issue was addressed to some degree by the end of the FESD program in FY 2013, and a back-up position when a permanent PO was detailed to EarthCube. PH POs also revised their solicitation by moving to a target date. Changes to other DEP program solicitations clarified differences between programs, allowing the description of PH scope to remain unchanged.</p>	

**IV. Questions about Portfolio.** Please answer the following about the portfolio of awards made by the program under review.

<b>RESULTING PORTFOLIO OF AWARDS</b>	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p><b>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</b></p> <p>Awards include a broad range of observational and modeling approaches, with data and methods that span the various sub-disciplines of geophysics.</p> <p>One major concern is that large observational projects (e.g. projects with budgets of ~\$1M) are becoming increasingly hard to fund. They simply take up a significant fraction of the program budget and therefore are subjected to heightened scrutiny. This problem has worsened with the end of the CD program. Such projects are critical to progress in geophysics, and this issue is of great concern to the COV.</p>	<p>Appropriate with concern about future</p>
<p><b>2. Are awards appropriate in size and duration for the scope of the projects?</b></p> <p>Overall, award sizes and durations are a reasonable match to the scope of funded projects. However, there was an anecdotal perception, based on reading the jackets, that proposal durations for standard (non-CAREER awards) have decreased. Average award duration as expressed in the PH proposal statistics provided to the COV has decreased from 3.2 to 2.4 years. However, because these numbers represent the actual duration of projects, as opposed to their awarded durations, their significance for the trend picked up in the jackets is difficult to evaluate.</p>	<p>Appropriate</p>
<p><b>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</b></p> <p>Among the 25 project jackets read for PH, 4-5 projects were truly innovative, and 1-2 were potentially transformative. Some of these were funded despite relatively low mail reviews. This demonstrates that checks and balances in the review system are working when it comes to recognizing high risk/high reward science.</p>	<p>Yes</p>

<p><b>4. Does the program portfolio include inter- and multi-disciplinary projects?</b></p> <p>The field is becoming more inter-disciplinary by nature, so almost all proposals touch upon more than one field. However, only a fairly small proportion of the projects whose jackets were read involved real intertwining of multiple disciplines in the proposed analyses. Taking a broader view, the large degree of co-funding is evidence of high inter-disciplinarity in proposals submitted and funded by the PH Program.</p>	<p>Yes</p>
<p><b>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</b></p> <p>The geographical distribution of proposals is uneven, and the distribution of awards is broadly similar to the proposal pool. This pattern was not of concern.</p>	<p>Appropriate</p>
<p><b>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</b></p> <p>More than 95% of PH awards go to PhD-granting institutions, and &gt;85% of awards go to the top 100 research institutions. Given the other efforts of PH POs to maintain diversity in their PI community, this bias to research institutions likely reflects the PH PI community more than anything else.</p>	<p>Appropriate</p>

<p><b>7. Does the program portfolio have an appropriate balance of awards to new investigators?</b></p> <p>New PIs made up 16% of the PH PI pool in 2011-2013. The percent of new PIs who received funding was 41%, compared to 57% in the total PH PI pool. In PH, early career PIs (&lt;10 years post-PhD) varied from 36% to 56% of the PI pool in 2011-2013, and early career PIs are funded at percentages closer to the 56% for the overall PI pool. PH is commended for their tracking of early career PIs in addition to new PIs. This participation and level of success among younger PIs is healthy. PH POs also provide excellent feedback to younger PIs.</p>	<p>Appropriate</p>
<p><b>8. Does the program portfolio include projects that integrate research and education?</b></p> <p>In the sense that training and supporting graduate students represents integration of research and education, nearly all proposals accomplish this goal. Some proposals include innovative new approaches to blending research and education, but not many. CAREER proposals are the exception, and in general they are very good in this area. Additional comments on CAREER proposals are provided in the DEP overview.</p>	<p>Yes</p>
<p><b>9. Does the program portfolio have appropriate participation of underrepresented groups<sup>2</sup>?</b></p> <p>Women made up 18% to 22% of the PH PI pool in 2011-2013, depending on how they are counted, and these percentages are comparable to the 20% of women in the American Geophysical Union (Holmes et al., EOS, 2011). 58% of female PIs were funded, on par with the percentage of all PIs who were funded (57%).</p> <p>Taken at face value, only 3% of PH PIs are underrepresented minorities (9 out of 327). However, because these numbers rely on self-reporting, actual levels of minority participation may be higher. 44% of minority PIs were funded, a figure that is lower than the 57% of all PIs. Please see further discussion of this issue in the <i>DEP Workforce</i> section of the DEP overview.</p>	<p>Appropriate for women. Unclear for underrepresented minorities.</p>

<p><b>10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.</b></p> <p>Please see <i>The Impact of DEP Science</i>, the last section in the DEP overview.</p>	<p>Yes</p>
<p><b>11. Additional comments on the quality of the projects or the balance of the portfolio:</b></p> <p>The quality of funded projects is amazing, judging by their impact. Clearly the right people and projects are getting funded, including high risk/high reward science. Over the 3-year period, PH projects produced 98-100 papers in Nature, Science, and PNAS, and more than 100 in JGR, EPSL, etc.</p>	

## Petrology and Geochemistry (CH)

The Petrology and Geochemistry (CH) subcommittee of the COV consisted of Charles Lesher (chair), Karen Fischer, Peter Hudleston, Mary Leech and Michael Poland. The subcommittee examined proposals from the Fall 2012 panel. Of the 92 proposals for which CH was the lead program, the subcommittee selected 20 unique jackets/projects for close reading and review, including 3 CAREER proposals. Each jacket was read by two subcommittee members. The jackets represented a few highly rated projects, the lowest-ranked proposals that were funded, the highest-ranked proposals that were not funded, proposals with discrepancies between mail and panel reviews, and proposals with no panel discussion due to conflicts of interest.

**I. Questions about the quality and effectiveness of the program's use of merit review process.** Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

<b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b>	<b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b>
<p><b>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</b></p> <p>CH has established a very thorough and comprehensive review process involving ad hoc (mail) reviews, panel review and final program office review and synthesis. (The average number of reviews per proposal ranged from 5.6 to 6.3 over 2011-2013.) This process has been in place for a long time, albeit refined over the years. It has resulted in a fair, balance and trusted (by the community) evaluation process, and has led to excellent decision-making. The POs do retain their authority to make the final decision based on mail and panel input, overall review criteria (intellectual merit/broader impacts), programmatic balance, budgets and career considerations. For the latter, in most cases we examined, decisions were well documented and justified.</p>	Yes
<p><b>2. Are both merit review criteria addressed</b></p> <p><b>a) In individual reviews?</b></p> <p><b>b) In panel summaries?</b></p> <p><b>c) In Program Officer review analyses?</b></p> <p>It is a general observation that ad hoc and panel reviewers do an excellent job of evaluating the proposed science, although due consideration of broader impacts is often lacking. POs make a good effort to insure that the panel addresses both intellectual merit and broader impact review criteria.</p>	Yes, though variable  Yes  Yes

<p><b>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</b></p> <p>Overall, reviewers for CH are found to take their task very seriously and provide thorough evaluation and constructive input. It is also clear that the panel members read these reviews closely and appropriately weigh numeric ranking versus the actual content of the review.</p>	<p>Yes</p>
<p><b>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</b></p> <p>Panel summaries by and large provide very good synthesis of the panel’s discussion, identify strengths and weaknesses, and voice overall support/lack of support for the proposed research. In a few cases, panel summaries were not substantive and therefore would not have been helpful to the proposer. We wish to note that very often the PO review provides even more context and detail regarding the panel discussion leading up to and influencing the PO final decision. We found the documentation by the PO very valuable in evaluating the review process. We also wonder if it might not be possible to transmit more of the information provided in the PO review directly to the PI (minus, of course, any confidential information). Finally, we applaud the panel for their effort (in at least two cases among jackets we reviewed) to provide thorough and constructive advice to young investigators who were not funded on how to prepare more competitive proposals. This is a great service to these young investigators, and the community as a whole.</p>	<p>Yes</p>
<p><b>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</b></p> <p>The documentation is very complete at all stages.</p>	<p>Yes</p>

<p><b>6. Does the documentation to the PI provide the rationale for the award/decline decision?</b></p> <p>Yes, for reasons provided in questions in I.1-I.4.</p>	<p>Yes</p>
<p><b>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</b></p> <p>We would like to reiterate our strong support for the current three-step process used by CH. While this is obviously more time-consuming for already over-worked POs and requires considerable engagement by the community of reviewers, the results are the quintessence of "peer-review" that is a hallmark of NSF.</p>	



**II. Questions concerning the selection of reviewers.** Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

SELECTION OF REVIEWERS	YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p><b>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</b></p> <p>POs do an excellent job selecting appropriate reviewers and catching reviews received that are off the mark.</p>	Yes
<p><b>2. Did the program recognize and resolve conflicts of interest when appropriate?</b></p> <p>We found no issues caused by conflicts of interest during the COV period.</p>	Yes
<p><b>Additional comments on reviewer selection:</b> None</p>	

**III. Questions concerning the management of the program under review.** Please comment on the following:

<b>MANAGEMENT OF THE PROGRAM UNDER REVIEW</b>	
<p><b>1. Management of the program.</b></p> <p>Over the 2011-2013 period covered by the 2014 COV, the CH program has undergone several transitions in POs. Sonia Esperança was a full-time PO (except in the spring of 2012), Bill Leeman was a PO in 2011-2012, and Jennifer Wade served as a half-time PO in spring 2011 and fall 2012, joining CH full-time in spring 2012. CH supports basic research on the formation and chemical composition of Earth materials in the deep crust, mantle, and core, including igneous and metamorphic rocks and ore deposits, volcanology, mineralogy and mineral physics, experimental petrology, and technique development. The POs do a significant amount of outreach at national and international meetings, particularly targeting early career and underrepresented faculty in earth sciences. As described below, the POs do an excellent job of managing the review process and the planning aspects of the program, despite the significant demands of their responsibilities outside of CH.</p>	
<p><b>2. Responsiveness of the program to emerging research and education opportunities.</b></p> <p>CH POs stay in close touch with emerging research and education opportunities. Early Earth and Volcanology have emerged as frontiers in the CH program, but CH is diverse and also remains open to other emerging themes in the field.</p>	
<p><b>3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.</b></p> <p>We applaud CH for maintaining a broad, flexible and nimble program that has been (and will continue to be) responsive to the community and emerging opportunities. We also applaud the POs for their proactive pursuit of co-funding. POs, with community input, considered possibilities for new ways of branding CH, but concluded that retaining the program name “Petrology and Geochemistry” and a broad solicitation was appropriate. The POs have identified sustaining labs and technical staff as a particular challenge for CH. Labs need long term support, i.e. greater than the 2-3 years currently typical for science proposals. As funding gets tighter, funding of technical staff becomes more precarious, and key lab staff are being lost. CH POs have been pursuing better coordination with the EAR Instrumentation and Facilities program. DEP-wide planning would likely great aid in managing/funding this critical support in the coming years.</p>	

**4. Responsiveness of program to previous COV comments and recommendations.**

The 2011 COV recommended that management engage the program to strategize about funding levels. The POs indicated that this has been accomplished to the degree possible within the EAR Division. Another recommendation was to develop a “succession plan” and hire another PO. This concern was addressed when Jennifer Wade became a full-time PO in 2012. The last COV also recommended “re-branding” CH and generating a white paper on the future of the program. POs gave serious consideration to these ideas. They concluded that a white paper is not consistent with the philosophy of a flexible program that can adapt to PI input and changes in the field. With community input, they also decided to retain “Petrology and Geochemistry” as the program name. As recommended by the last COV, CH has revised their solicitation. The program description/synopsis language clarifies the kind of science that CH funds. CH moved away from a hard deadline to a Target Date, and pushed back the Target Date to later in January to avoid conflicts with end-of-year administrative closures at Universities, the Fall Meeting of the AGU, and holidays; and CH now restricts the number of proposals per PI to a maximum of two for each round.

**IV. Questions about Portfolio.** Please answer the following about the portfolio of awards made by the program under review.

<b>RESULTING PORTFOLIO OF AWARDS</b>	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p><b>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</b></p> <p>The portfolio of awards in CH is very diverse and represents the discipline and sub-disciplines very well.</p>	Appropriate
<p><b>2. Are awards appropriate in size and duration for the scope of the projects?</b></p> <p>The CH program has had a flat/declining budget for years and has done an admirable job maintaining the high quality of the program (support for competitive research) in the facing of the rising costs of doing research. Average project duration has remained relevantly constant (~3.4 yrs) factoring in no-cost-extensions. Grants average \$80K (down from ~\$100K a few yrs ago) and principally support graduate students, PI summer salary and field/experimental/analytical expenses. CH also supports soft-money researchers and to a lesser extent post-docs and technicians. Thus, a great deal of CH budget is directed toward training/education of the next generation of earth sciences. The COV is concerned that further declining in core funding will jeopardize this essential and critical role for CH.</p>	Appropriate with concerns about the future
<p><b>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</b></p> <p>CH supports many innovative/potentially transformative projects and is willing to take risks leading to high impact research. At the same time, CH is vigilant about maintaining support for excellent but more standard research programs that advance the field by providing new and fundamental observations (field and experimental), critical data and modeling endeavors.</p>	Yes

<p><b>4. Does the program portfolio include inter- and multi-disciplinary projects?</b></p> <p>In general, CH funds are used to support focused and (sub)disciplinary studies. However, very often these projects have broad impacts on the field, for example developing new analytical methods, experimental tools, models, computer code, etc. that find broad applicability within the CH community and beyond (e.g. geophysics, tectonics, and even soil science and hydrology, climate science, among others).</p>	<p>Yes</p>
<p><b>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</b></p> <p>The CH portfolio for the COV review period reflects the geographical distribution of submitted proposals (which is obviously weighted to states with more research intensive PhD institutions). It is also clear that the POs keep an eye out for opportunities to fund PIs from smaller schools and EPSCoR states.</p>	<p>Appropriate</p>
<p><b>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</b></p> <p>Among CH awards, &gt;80% go to PhD-granting institutions and &gt;70% go to the top 100 research institutions. Nonetheless, as indicated above, POs make an effort to also fund PIs from non-PhD institutions.</p>	<p>Appropriate</p>
<p><b>7. Does the program portfolio have an appropriate balance of awards to new investigators?</b></p> <p>New PIs make up 18% of the PI pool in CH. The percentage of new PIs receiving awards (41%) is lower than the percentage of all PIs with awards (54%), but this balance does not seem inappropriate. CH POs take great care to provide new PIs with feedback on their proposals, and typically use new PI/early career status as a positive factor in funding decisions.</p>	<p>Appropriate</p>

<p><b>8. Does the program portfolio include projects that integrate research and education?</b></p> <p>The vast majority of projects in the CH program portfolio support graduate students and thus naturally integrate research and education. There is also a high level of involvement of undergraduates in CH projects and many PIs have engaged in considerable K-12 and outreach activities.</p>	<p>Yes</p>
<p><b>9. Does the program portfolio have appropriate participation of underrepresented groups<sup>2</sup>?</b></p> <p>Women made up 23% of the CH PI pool in 2011-2013, a percentage that is roughly comparable to the proportion of women in the American Geophysical Union (Holmes et al., EOS, 2011). 57% of female PIs were funded, slightly higher than the percentage of all PIs who were funded (54%).</p> <p>In program statistics, only 4% of CH PIs are underrepresented minorities (11 out of 318). However, because these numbers rely on self-reporting, actual levels of minority participation may be higher. 46% of minority PIs were funded, a figure that is lower than the 54% of all PIs. Further discussion of this issue is provided in the <i>DEP Workforce</i> section of the DEP overview.</p>	<p>Appropriate for women.</p> <p>Unclear for underrepresented minorities.</p>
<p><b>10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.</b></p> <p>Please see <i>The Impact of DEP Science</i>, the last section in the DEP overview.</p>	<p>Yes</p>
<p><b>11. Additional comments on the quality of the projects or the balance of the portfolio:</b></p> <p>The CH program has a balanced portfolio that reflects the breadth of the field and is responsive to emerging/new directions. We support the POs continual consideration of program scope and branding of this core program, and we consider the current name “Petrology and Geochemistry” as very well suited and certainly not outdated or stale. At the same time, we would support including “volcanology” in the program name.</p>	

## EarthScope (ES)

The EarthScope (ES) subcommittee of the COV consisted of Ed Garnero (chair), Steven Day, James Evans, Carolina Lithgow-Bertelloni, and Calvin Miller. The subcommittee examined proposals from the Fall 2012 panel. Of the proposals for which ES was the lead program, the subcommittee selected 20 unique jackets/projects for close reading and review, including the one CAREER proposal. Each jacket was read by two subcommittee members. The jackets represented a few highly rated projects, the lowest-ranked proposals that were funded, the highest-ranked proposals that were not funded, proposals with discrepancies between mail and panel reviews, and proposals with no panel discussion due to conflicts of interest.

**I. Questions about the quality and effectiveness of the program’s use of merit review process.** Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

<b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b>	<b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b>
<p><b>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</b></p> <p>The system of ad hoc, panel, and PO reviews used in this program and NSF EAR is appropriate and an excellent way to engage expertise, commentary, and guidance from scientists working in areas similar to the proposed work. This approach to evaluating scientific proposals maximizes fairness for the proposer.</p> <p>The average number of reviews per proposal ranged from 5.8 to 7.1 over 2011-2013 (a 60% - 70% return rate). 6-9 panelists (some early career) discussed &gt;80% of the proposals in most rounds. All non-conflicted panelists read all proposals.</p>	Yes
<p><b>2. Are both merit review criteria addressed</b></p> <p><b>a) In individual reviews?</b></p> <p><b>b) In panel summaries?</b></p> <p><b>c) In Program Officer review analyses?</b></p> <p>Not all mail reviewers were consistent in their commentary about the broader impacts of the proposed projects. Broader impacts often receive less attention than intellectual merit. This is likely related to many reviewers/scientists being slow to understand and appreciate the transition at NSF to emphasize broader impacts. Perhaps the POs can emphasize more strongly the definition and importance of broader impacts when they are present at national meetings, as well as in program announcements, and certainly in their correspondence with PIs with funding decisions. The POs have been working hard on this front, but apparently the scientific community has been slow to embrace this transition.</p>	<p>Yes, though variable</p> <p>Yes</p> <p>Yes</p>

<p><b>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</b></p> <p>For the proposals we looked at, nearly all the ad hoc external reviews had substantive comments that explained their assessment of the reviewed proposal. The selection of reviewers by the POs is to be applauded, because reviewer expertise was clearly evident.</p>	<p>Yes</p>
<p><b>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</b></p> <p>The panel decision was supported in the panel summaries, although it is noteworthy that the average panel scores were typically lower than the average mail review scores (the average difference is 0.7 lower). The COV raised the possibility that the composition of the panel for the round of proposals we reviewed may have been uncharacteristically hard on the proposals. This emphasizes the importance of the PO continuing to strive to populate the panel with fair-minded scientists.</p>	<p>Yes</p>
<p><b>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</b></p> <p>The documentation was clear for purposes of determining the rationale for the funding decision. However, the COV struggled with understanding the justification for some fund/decline decisions relative to each other. From the information provided in the jacket, we could not completely extract the justification for some decisions over others since the mail scores were often very high, but then the panel gave a low score. It was not straightforward to extract a consistent criterion. The PO made clear that in some cases the mail reviews provided high scores, but interpretation of the review text indicated that a lower score would have been more appropriate, and the panel went with the latter. Also, the panel appeared to take broader impacts more seriously than the ad hoc reviews. This may explain some of the reduced panel scores relative to the ad hoc scores. One particular case was a CAREER proposal that was ranked highly by the ad hoc reviews. The COV felt that the information provided did not provide sufficient (consistent) reasoning for the rejection. We encourage the POs to log all the information that gives context for the decisions, especially relative to each other. We reiterate that we are not questioning the fund/decline decisions, but advocate greater and more consistent documentation. It is quite clear that the POs have worked very hard in the review process.</p>	<p>Yes</p>



<p><b>6. Does the documentation to the PI provide the rationale for the award/decline decision?</b></p> <p>The system of communicating decision information to the PI is very important for the PI, and many of the letters were thorough and effective in communicating the decision and the rationale behind it. However, the PO decision letters to the PIs were quite varied, from exemplary in their clarity and detail, to terse. For declines, several PO letters to PIs simply recommended that they view the panel and external reviews and consider resubmitting the proposal. But for some of these cases the external ad hoc letters were quite strong. This opens the door for PI confusion: great external reviews but a rejection decision and no information from the PO for how to improve in a resubmission. A more even treatment of the summary analysis of the proposal in the PO letter to the PI across proposals is desirable.</p>	<p>Yes</p>
<p><b>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</b></p> <p>The three-step merit review process is applauded – it is fair and effective. The POs are engaged in the community by attending conferences and workshops; this keeps them abreast of important and exciting discovery-class research. This is certainly the case for the ES POs: they are very engaged and aware. Regarding the use of the merit system of review, the COV had a suggestion for the ES POs. We learned in discussion with the POs that the highest ad hoc rankings of proposals defined a list that would not need to be discussed further unless any panel member expressed the desire to bring any of them into review by the panel. This resulted in several top-ranking proposals being reviewed by the panel, and ultimately rejected. The COV was concerned that this is an uneven process and recommends that a different protocol be considered. For example, the top-rated proposals can either all be reviewed, or all be excluded from review.</p>	

**II. Questions concerning the selection of reviewers.** Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

SELECTION OF REVIEWERS	YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p><b>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</b></p> <p>This was an excellent aspect of the merit review process, and the POs are to be applauded for their success in getting experts in the disciplines of proposals.</p>	Yes
<p><b>2. Did the program recognize and resolve conflicts of interest when appropriate?</b></p> <p>Conflicts of interest were avoided by not releasing reviews that were conflicted, panelists leaving the room when necessary, and panelists not attending a panel when they had a proposal in the round of submissions.</p>	Yes
<p><b>Additional comments on reviewer selection:</b></p> <p>The POs made excellent use of the community by using their own background and knowledge to select reviewers who adequately covered the disciplines of the proposal being evaluated, including international reviewers.</p>	

**III. Questions concerning the management of the program under review.** Please comment on the following:

<b>MANAGEMENT OF THE PROGRAM UNDER REVIEW</b>	
<p><b>1. Management of the program.</b></p> <p>The ES POs during the 2011-2013 were Greg Anderson, with Charles Estabrook and later Maggie Benoit</p> <p>Management of the program has been excellent. The POs appeared to take into account the health and needs of the community (tenure, early career, etc.) when necessary. There was an excellent overarching view of the whole program, mostly excellent proposal review (we previously noted some unevenness in this regard), and feedback and engagement with PIs before and after submission. There is excellent community engagement (conferences, community development) and professionalism.</p>	
<p><b>2. Responsiveness of the program to emerging research and education opportunities.</b></p> <p>ES is extremely responsive to emerging research and education opportunities. For the emerging research, it is a facilities-based program, and thus new research and discovery is always happening from the excellent state-of-the-art observatories. For education and outreach, ES is vigorously engaged via various workshops and activities, and the program is very supportive of scientists and educators exploring new project ideas within the program.</p>	
<p><b>3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.</b></p> <p>Community engagement is high for this program. Via the EarthScope National Office, and the EarthScope Steering Committee, the POs are very aware of internal and external processes and activities related to the science aligned with ES themes. The POs are very engaged, and thus prioritization is excellent.</p>	
<p><b>4. Responsiveness of program to previous COV comments and recommendations.</b></p> <p>The 2011 COV report had specific suggestions, and the PO went through each one and noted the responses to each suggestion. They include: adding clarity to the program solicitation, improving the review return rate through personal “pleas,” advising PIs on how to handle proposals that overlap programs, encouraging CAREER proposals and other proposals from early career PIs, and considering (but not implementing) two proposal tracks based on project scale. In addition to these, the PO noted other changes made proactively to the program, all which were forward thinking and helpful for the success of the program. Thus the POs were very responsive to the previous COV.</p>	

**IV. Questions about Portfolio.** Please answer the following about the portfolio of awards made by the program under review.

<b>RESULTING PORTFOLIO OF AWARDS</b>	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p><b>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</b></p> <p>ES science is multi-disciplinary by nature, with the managed facilities spanning a wide disciplinary scope. The submitted proposals reflect this disciplinary breadth, and the portfolio is exemplary in its balance of awards across disciplines.</p>	Appropriate
<p><b>2. Are awards appropriate in size and duration for the scope of the projects?</b></p> <p>Overall, awards sizes were appropriate, although due to budgetary constraints, awards were typically made at 90%-95% of the requested level.</p>	Appropriate
<p><b>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</b></p> <p>Definitely. The portfolio includes proposals that deal with the very nature of earthquakes, volcanic processes, and details relating to the structure and evolution of the North American continent. The proposal submissions represent exemplary breadth in innovation and capacity for transformative discovery class science.</p>	Yes

<p><b>4. Does the program portfolio include inter- and multi-disciplinary projects?</b></p> <p>Again, definitely. Most of the proposals were cross-disciplinary and multi-PI.</p>	<p>Yes</p>
<p><b>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</b></p> <p>ES had proposals across all but 11 states in 2011-2013.</p>	<p>Appropriate</p>
<p><b>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</b></p> <p>More than 85% of awards go to PhD-granting institutions, and more than 75% of awards go to the top 100 research institutions. However, this distribution likely reflects the PI community more than anything else. Efforts are made to fund PIs at a range of institutions.</p>	<p>Appropriate</p>
<p><b>7. Does the program portfolio have an appropriate balance of awards to new investigators?</b></p> <p>New PIs make up 18% of the PI pool in ES. The percentage of new PIs receiving awards (15%) is much lower than the percentage of all PIs with awards (40%). This gap is larger than in PH, CH and TE, but is more similar to CD, and may reflect the multi-disciplinary nature of many ES projects. In general, ES POs provide new PIs with excellent feedback on their proposals.</p>	<p>Appropriate</p>

<p><b>8. Does the program portfolio include projects that integrate research and education?</b></p> <p>By its very nature, the program has a significant education and outreach component. Moreover, the ES panel places a great deal of emphasis on broader impacts when evaluating proposals.</p>	<p>Yes</p>
<p><b>9. Does the program portfolio have appropriate participation of underrepresented groups<sup>2</sup>?</b></p> <p>Women made up 22% of the ES PI pool in 2011-2013, a percentage that is roughly comparable to the 20% of women in the American Geophysical Union (Holmes et al., EOS, 2011). 37% of female PIs were funded, a figure that is only slightly lower than the percentage of all PIs who were funded (40%).</p> <p>Only 3% of ES PIs identified themselves as underrepresented minorities (11 out of 318). However, because these numbers rely on self-reporting, actual levels of minority participation may be higher. 14% of minority PIs were funded (1/7). This figure is much lower than the 40% of all PIs who were funded. It is, however, based on a very small sample (for example, if 2 more minority PIs had been funded, the percentages would be on par). Nonetheless the minority PI funding rate definitely warrants further study. Additional discussion of this issue is provided in the <i>DEP Workforce</i> section of the DEP overview.</p>	<p>Appropriate for women.</p> <p>Unclear for underrepresented minorities.</p>
<p><b>10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.</b></p> <p>Please see <i>The Impact of DEP Science</i>, the last section in the DEP overview.</p>	<p>Yes</p>
<p><b>11. Additional comments on the quality of the projects or the balance of the portfolio:</b></p> <p>The projects appear excellent and demonstrate that important research discovery is actively happening in the ES Program.</p>	

## Continental Dynamics (CD)

The Continental Dynamics (CD) subcommittee was chaired by Anke Friedrich and consisted of 10 members, all of the COV except for Fischer. NSF made available proposal jackets for the 2011 and 2012 (59 and 61 proposals, respectively, with 12 projects in each year). Competitive proposals were not accepted in 2013 due to the phase-out of the program. Initially the CD subcommittee planned to review all unique jackets/projects for each year. However, for 2012, the only successful project was unavailable for examination because one of the collaborators is a member of the National Science Board (NSB). Since the COV members were unable to investigate the differences between the successful and unsuccessful proposals from 2012, the committee decided to limit its analysis to the 2011 solicitation.

**I. Questions about the quality and effectiveness of the program's use of merit review process.** Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

<b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b>	<b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b>
<p><b>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</b></p> <p>The CD subcommittee unanimously and strongly agreed that mail reviews, panel discussions, and a final decision by the PO are appropriate and important elements of a successful review process. The COV particularly acknowledges the thorough, insightful and expert review analysis provided by the PO. An important element is the large number of mail reviews and the efforts associated in soliciting them.</p> <p>The average number of reviews per proposal ranged from 6.5 to 8.0 over 2011-2013. All non-conflicted panelists read all proposals.</p>	Yes
<p><b>2. Are both merit review criteria addressed</b></p> <p><b>a) In individual reviews?</b></p> <p><b>b) In panel summaries?</b></p> <p><b>c) In Program Officer review analyses?</b></p> <p>The documentation of panel discussion in jackets was found to be very thorough. The documentation of the factors leading to the funding decision in the PO review summary was found to be detailed and complete in most cases. The documentation of the evaluation of the proposal relative to merit review criteria, as communicated to the PIs, could have been more detailed. PIs would have benefitted from more detailed hints as to how to improve their proposal, along the lines of the detailed analysis typically found in the PO review summaries.</p>	<p>Yes, in most cases</p> <p>Yes</p> <p>Yes</p>

<p><b>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</b></p> <p>About 2/3 of the reviews were fairly thorough and clearly explained. In about 1/3 of the cases, reviews came to conclusions without providing a detailed assessment.</p>	<p>Yes, mostly</p>
<p><b>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</b></p> <p>The rationale for the panel consensus was documented clearly in nearly all of the proposals analyzed.</p>	<p>Yes</p>
<p><b>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</b></p> <p>In several cases, documentation of the funding decision was not clearly documented, and/or did not appear to reflect some concerns raised by the reviewers. The subcommittee discussed one case with PO, and the funding rationale in this instance was clarified.</p>	<p>Yes in many cases, but not in all cases</p>



<p><b>6. Does the documentation to the PI provide the rationale for the award/decline decision?</b></p> <p>In a few cases, no detailed explanation of the funding decision was communicated to the PIs beyond the panel summary and reviews.</p>	<p>Yes, in most cases</p>
<p><b>7. Additional comments on the quality and effectiveness of the program's use of merit review process:</b></p> <p>The three-step merit review process is especially helpful in the CD program, where large and relatively complicated projects are prevalent.</p>	

**II. Questions concerning the selection of reviewers.** Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

SELECTION OF REVIEWERS	YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p><b>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</b></p> <p>Subcommittee members agreed that the selection of reviewer expertise is good to excellent in all cases.</p>	Yes
<p><b>2. Did the program recognize and resolve conflicts of interest when appropriate?</b></p> <p>The documentation in the jackets shows that conflicts were identified and resolved. It appears that the reviewers, the panel members and the PO were all aware of potential conflicts.</p>	Yes
<p><b>Additional comments on reviewer selection:</b></p> <p>The subcommittee recognizes the difficult and time-consuming efforts that go into obtaining a large number of expert reviewers for each proposal. The international members of the COV acknowledge in particular that the internationally known high reputation of the CD program is rooted in the PO’s ability to solicit expert reviewers.</p>	

**III. Questions concerning the management of the program under review.** Please comment on the following:

<b>MANAGEMENT OF THE PROGRAM UNDER REVIEW</b>	
<p><b>1. Management of the program.</b></p> <p>Leonard Johnson has been the PO for the CD program throughout its lifespan. Overall, the program is well managed, especially considering the demands on the PO on time beyond the CD program, and the large multi-disciplinary nature of the projects funded by the program. The review process is handled effectively, as discussed in Parts I and II. Extra complexities that arose due to the end of the CD program in 2013 were handled in a reasonable manner.</p>	
<p><b>2. Responsiveness of the program to emerging research and education opportunities.</b></p> <p>Very good. The PO has responded in a timely fashion to scientific trends in the geoscience community, resulting in the creation of a new program called Integrated Earth Sciences (IES), and the termination of CD. The new IES program is integrative and interdisciplinary in nature, providing a new home for collaborative proposals that would have previously gone to CD. However, the scope of IES is much broader than CD and its management is now shared with the Shallow Earth Processes section.</p>	
<p><b>3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.</b></p> <p>The PO is knowledgeable about developments in the field, and has encouraged proposals that take advantage of these developments. Much of the discussion that led to the phase-out of CD and the creation of IES appears to have been internal to NSF. A workshop that involves the research community in discussions of IES directions would be a good idea.</p>	
<p><b>4. Responsiveness of program to previous COV comments and recommendations.</b></p> <p>In addition to the DEP-wide recommendations, the 2008-2011 COV provided recommendations specific to the CD program. These included providing some continuity of reviewers over repeated proposal submissions, tracking the fates of resubmitted proposals, and better documenting PO interactions with PIs. The PO indicated that he has followed up on these recommendations, although the CD subcommittee found that documentation of some funding decisions was incomplete or unclear. The 2008-2011 COV also recommended a community workshop to help define the directions for CD, which did not take place. The PO indicates that a workshop for IES will be held within the next couple of years.</p>	

**IV. Questions about Portfolio.** Please answer the following about the portfolio of awards made by the program under review.

<b>RESULTING PORTFOLIO OF AWARDS</b>	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE
<p><b>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</b></p> <p>Yes, to the extent we can judge by the set of proposals we were provided access to. CD reflects the efforts of the community across a broad range of activities. In summary, the overall portfolio is relatively well balanced.</p>	Appropriate
<p><b>2. Are awards appropriate in size and duration for the scope of the projects?</b></p> <p>Yes, except for the last proposal funded under CD, which had to be cut and limited in duration owing to program termination. A program that allows multi-year funding and larger awards, in particular for observationally-based research projects, is a high priority for DEP, and the loss of CD has added pressure to other DEP programs. We strongly recommend that access to this type of funding for DEP-themed projects be increased, either in the new IES program or other programs.</p>	Appropriate
<p><b>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</b></p> <p>The proposals reviewed did include research proposals that were considered highly innovative by the expert reviewers, the panel, and the PO.</p>	Yes

<p><b>4. Does the program portfolio include inter- and multi-disciplinary projects?</b></p> <p>This particular program by design encourages and funds multi-disciplinary projects.</p>	<p>Yes</p>
<p><b>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</b></p> <p>Proposals from California, Colorado, New York, Texas, Arizona, and Missouri dominated in 2011-2013, and awards were concentrated in California, Arizona, New York, Massachusetts, and Pennsylvania. However, this distribution is not especially significant, given the relatively small number of projects and awards.</p>	<p>Appropriate</p>
<p><b>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</b></p> <p>More than 85% of CD awards went to PhD-granting institutions, and more than 75% went to the top 100 research institutions. This balance reflects the nature of the PIs who are likely to become involved in large, multi-disciplinary projects.</p>	<p>Appropriate</p>
<p><b>7. Does the program portfolio have an appropriate balance of awards to new investigators?</b></p> <p>For the funding period 2011 - 2013, seven new PIs submitted proposals, of which one was funded (14%). These new PIs represented 6% of the total proposal pool. While this representation of new PIs is low relative to other DEP programs, it is not surprising because the CD program invited large, multi-PI proposals, and such proposals are more likely to be submitted by experienced PIs.</p>	<p>Appropriate</p>

<p><b>8. Does the program portfolio include projects that integrate research and education?</b></p> <p>Some projects include extensive education and outreach components, related to project research, that go well beyond the standard broader impacts in smaller proposals.</p>	<p>Yes</p>
<p><b>9. Does the program portfolio have appropriate participation of underrepresented groups<sup>2</sup>?</b></p> <p>Women made up 21% of the CD PI pool in 2011-2013, a percentage that is roughly comparable to the 20% of women in the American Geophysical Union (Holmes et al., EOS, 2011). 32% of female PIs were funded, a figure that is similar to the percentage of all PIs who were funded (34%).</p> <p>Only 7% of CD PIs identified themselves as underrepresented minorities (5 out of 117). However, because these numbers rely on self-reporting, actual levels of minority participation may be higher. 60% of minority PIs were funded (3/5). This figure is much higher than the 40% of all PIs who were funded, and is also larger than the funded percentages of minority PIs in other DEP programs. However, these statistics are based on very small numbers. Additional discussion of this issue is provided in the <i>DEP Workforce</i> section of the DEP overview.</p>	<p>Appropriate for women.</p> <p>Unclear for underrepresented minorities.</p>
<p><b>10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.</b></p> <p>Please see <i>The Impact of DEP Science</i>, the last section in the DEP overview.</p>	<p>Yes</p>
<p><b>11. Additional comments on the quality of the projects or the balance of the portfolio:</b></p> <p>Over its history, the CD program has funded many high quality projects that have played a huge role in our understanding of continental evolution.</p>	

## OTHER TOPICS (For all DEP Programs)

### **1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.**

There are no obvious gaps in disciplinary areas covered by DEP programs. DEP POs are keenly attuned to developments in the field and trends in the research community through their regular activities as POs and community science initiatives.

### **2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.**

DEP programs function smoothly and at a high intellectual level, despite budget constraints and other demands on PO time.

### **3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.**

The COV highlighted three agency-wide issues.

1) Budgets are an obvious issue that is agency-wide. Static or declining budgets mean fewer proposals can be supported, and then at reduced levels. Constrained budgets are already limiting the size and scope of projects that can be supported.

2) POs face many competing demands on their time. New initiatives should be weighed carefully against their workload demands.

3) More efficient use of PO time could be achieved by upgrading the electronic tools used in the review process and other aspects of proposal management.

More discussion of these topics appears in the DEP overview, under *Program Planning and Management* and *NSF-wide Issues*.

### **4. Please provide comments on any other issues the COV feels are relevant.**

DEP programs are producing amazing science, and while DEP POs make efforts to publicize this work within and beyond NSF, better help from the press and public affairs staff at NSF would be beneficial. In addition, we suggest allocating non-PO staff time (perhaps an intern) to collecting data on high profile publications and other measures of program success.

### **5. NSF would appreciate your comments on how to improve the COV review process, format and report template.**

Overall, the COV meeting at NSF ran smoothly and productively. PO reports and our discussions with POs were illuminating and constructive. Nonetheless, we do have several suggestions for the next COV. Initial discussions of how to sample jackets from the designated proposal cycle were time-consuming. We suggest providing the next COV with the relevant proposal lists a couple of months ahead of the meeting at NSF. All identifying information could be redacted. With only the average mail review and panel scores, plus an indication of funding status, useful discussions of jacket sampling and selection

could occur well ahead of the meeting, allowing the program subcommittees more time for jacket reading and discussion while at NSF. It would also be helpful to have the program statistics further ahead of the meeting at NSF. Finally, we suggest continuing the very helpful practice of having one person from the last COV serve on the subsequent COV.

**SIGNATURE BLOCK:**

*Karen M. Fischer*

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For the Deep Earth Processes  
Section COV  
Karen M. Fischer  
Chair