

Meeting of Young Researchers in the Earth Sciences
(*MYRES*): A conference series and community
development initiative

The MYRES Steering Committee

Thorsten Becker	University of California, San Diego
Magali Billen	University of California, Davis
James Kellogg	Harvard University
Jeanne Hardebeck	USGS Menlo Park
Cin-Ty Lee	Rice University
Laurent Montesi	Woods Hole Oceanographic Institution
Wendy Panero	University of Michigan
Frederik Simons	Princeton University
Shijie Zhong	University of Colorado, Boulder

www.myres.org

info@myres.org

Proposal submitted to the National Science Foundation
EAR Education and Human Resources Program
August 29, 2003

Contents

Project summary	3
Intellectual merit	3
Broader impact	3
Introduction	4
Results from prior NSF-funded research	5
Previous funding for C.-T. Lee (acting PI for the <i>MYRES</i> steering committee)	5
<i>MYRES</i> conferences	6
Scope	6
Location	7
Format	7
Organizational structure	9
Community involvement and operational procedures	9
Timeline	10
Senior advisory panel	11
Education and community outreach	12
Quality controlled instruction	12
<i>MYRES</i> online resources	13
Evaluation and accountability	14
Funding	14
Summary	15
Conference program for <i>MYRES</i> I	15
Heat, Helium, Hotspots, and Whole Mantle Convection	15
Personnel	15
Program	16
Appendix	19
Future meeting topics	19
Understanding the dynamics of the lithosphere: Multidisciplinary approaches to the behavior of plate boundaries	19
Conference evaluation	22
Initial evaluation	22
Follow-up questionnaire	24

Project summary

Intellectual merit

The establishment of a biennial conference series, the *Meeting of Young Researchers in the Earth Sciences (MYRES)*, for junior scientists in geochemistry, geodynamics, mineral physics, seismology, and related Solid Earth fields is proposed. The aim of *MYRES* is to further science by accelerating the growth of an interdisciplinary, international, open, and unbiased community of colleagues who interact regularly to informally exchange ideas, data, and tools, and formulate new collaborative research projects. The focus of each *MYRES* meeting will be the review and discussion of a major outstanding problem in Earth Science. By bringing together specialists in this novel venue to educate each other about the specific issues each discipline can address, a broad understanding of the nature of the constraints different disciplines can provide on the problem will be generated. From this, a broader understanding, new ideas for each specialist's own research, and new multidisciplinary research initiatives will be gained.

The proposed workshops are aimed specifically at (but not strictly limited to) the younger members of the community (from senior graduate students to junior faculty) with the goal of creating an environment in which fundamental assumptions and paradigms are openly discussed. Peer-reviewed keynote lectures will be given by junior faculty or senior post-docs to give an overview of the current state of their sub-discipline, the key assumptions inherent therein, and the degree to which constraints should be considered "firm" or "soft". Small dedicated conferences with similar format exist, but often tend to be dominated in attendance and scientific agenda by senior members of the community. The special environment which *MYRES* will provide and the grass-roots approach will relax some of the limitations and obstacles to cross-departmental interaction of junior scholars that exist in places, not least by supporting conference fees and travel support for all students. Beyond the individual meetings, the *MYRES* web-site will provide free access to all instructional material and serve as a community resource year-round.

Broader impact

MYRES' goals are to establish a framework for unhindered, international scientific cooperation. Such community-building efforts will not only have a substantial educational impact but will help to improve the overall effectiveness of research in the Earth Sciences. *MYRES'* will:

- educate participants about basic and cutting edge results in each discipline,
- critically evaluate common assumptions and methods,
- provide an environment for specialists to jointly work on a hard problem and formulate solution strategies,
- foster collaboration among research groups and disciplines not traditionally aligned,
- give young researchers training in communicating effectively across disciplines,
- be judged and held accountable by means of questionnaires and other forms of feedback and review during all stages of the proceedings, and
- produce openly accessible and high-quality instructional material in electronic form, to be hosted on the *MYRES* website which will eventually serve as a general community forum.

Meeting of Young Researchers in the Earth Sciences (*MYRES*): A conference series and community development initiative

The MYRES Steering Committee

Thorsten Becker (UCSD), Magali Billen (UC Davis), James Kellogg (Harvard),
Jeanne Hardebeck (USGS Menlo Park), Cin-Ty Lee (Rice), Laurent Montesi (WHOI),
Wendy Panero (UMich), Frederik Simons (Princeton), and Shijie Zhong (UCol, Boulder)

Introduction

Fundamental problems in the Earth Sciences remain hotly debated even after decades of research. For example, our understanding of the style of mantle convection and the origin of hotspots has been substantially modified in the last few years by new observational, laboratory, and modeling work. While this process of change is clearly fundamental for all scientific endeavor, parts of the mantle convection discussion appear to be hindered by lack of effective communication between the disciplines. To help address some of these problems, we propose a conference series and community effort aimed at the people responsible for remedying them: the younger researchers in the community. We believe that a conference in which the conveners, keynote speakers, and conferees are all young researchers will have a number of advantages over traditional formats.

First, we intend to structure the conference program around the underlying mechanisms and processes pertaining to the problem under consideration, as opposed to disciplines of Earth Sciences, to include a comprehensive and interdisciplinary approach from the ground up. Second, by explicitly focusing on younger scientists, we can dispense with the pretense that everyone in the room is intimately familiar with every sub-discipline of Solid Earth sciences. Presenters will be asked to bring everyone up to speed with the help of tutorials so that discussions can involve the entire room. This will prevent the phenomenon in which a four-day conference of a hundred people turns into four one-day conferences of twenty-five specialists each. Third, both the lectures and the commentary will come from people who are not among the usual players at meetings. By giving voice to alternative explanations, we hope to elucidate weaknesses in the conventional wisdom, diversify the body of thought, and force us all to defend our assumptions. We will ensure scientific soundness by having experienced junior people as keynote speakers. A senior faculty advisory panel with members from different disciplines will also be present to provide guidance if needed. Fourth, such a conference setting will immediately broaden the community of colleagues available to each of the participants beyond that defined by her or his advisor's coworkers and friends. This will ease the access to new ideas, data, and tools across scientific "families" at an early career stage.

We see these community building efforts as the most important outcome of *MYRES* and expect many high quality collaborations to result. *MYRES* meetings will strive to provide an open, unbiased, international, informal, and democratic environment for exchange of knowledge and ideas, supplemented by an online community forum. Instructional material and each conference program will be peer-reviewed and openly accessible, and the conference performance will be critically evaluated by attendees and the community at large.

The *MYRES* initiative is not intended to replace traditional professional conferences; we very much recognize the need for young researchers to learn to defend their ideas before a senior audi-

ence. We believe, however, that there is significant scientific, educational, and cultural value in a self-organized gathering of young scientists sharing ideas and challenging dogma.

We request initial funding for a four year period which would entail two pilot *MYRES* meetings and describe a first workshop schedule and a draft second *MYRES* program below. Depending on our experience with the first *MYRES* and the evaluation of the feedback which we will request, the second workshop could potentially have a modified format. We hope that we can demonstrate the positive impact of *MYRES* after four years and, if successful, intend to reapply for an extension of the conference series and other community activities thereafter.

Results from prior NSF-funded research

Previous funding for C.-T. Lee (acting PI for the *MYRES* steering committee)

EAR-0309121: “Thermodynamic, Petrologic, Geochemical and Isotopic Constraints on Metal (Re, Pt, Pd, Ir, Ru, Os and Other Metals) Mobility During Hydrothermal Serpentinization of Ultramafics.” Start date: 1 June, 2003. This is Lee’s first NSF-funded project on which he is the PI (PI eligibility as of July, 2002). The study seeks to understand the mobility of trace metals during hydrothermal serpentinization by combining field mapping of a harzburgite-serpentinite transition, thermodynamic modeling, trace element analyses by ICP-MS, and Sr and Os isotopic measurements by TIMS. The goals are to better understand the role of hydrothermal serpentinization as a sink or source of various metals into and out of the marine environment. Lee with one graduate (Nathan Brill) and one undergraduate student (Nivedita Thiagarajan) completed the mapping in June (2003) and are currently processing samples. For more information see www.ruf.rice.edu/~ctlee/SERP.htm.

EAR-0236761: “Upgrade of the JEOL JSM-840 Scanning Microscope” (Joint with A. Lutge). The project has just started and the upgrade of the system is underway (new detector, EDS, digital image acquisition, and a new sputter coater).

NSF Graduate Fellowship: As a graduate student, C.-T. Lee benefited from an NSF graduate fellowship from 1996 to 1999 and an NSF grant (EAR 9909526) awarded to R. L. Rudnick. NSF funds were used by Lee to study deep lithospheric dynamics beneath the North American Cordillera using a combination of Re-Os isotopic systematics, major-element chemistry, and thermobarometry on ultramafic xenoliths. This research led to some interesting discoveries; the Mojave Province is underlain by ancient and fertile lithospheric mantle, while most of the lithospheric mantle beneath the Sierra Nevada batholith is Phanerozoic in age.

Four relevant publications are shown below (additional publications can be found at www.ruf.rice.edu/~ctlee/publish.htm).

- Lee, C.-T., Rudnick, R. L., and Brimhall, G. H., Jr. Deep lithospheric dynamics beneath the Sierra Nevada during the Mesozoic and Cenozoic as inferred from xenolith petrology, *G³*, 2, 2001GC000152.
- Lee, C.-T., Yin, Q-Z, Rudnick, R. L., Jacobsen, S. B., 2001, Preservation of ancient and fertile lithospheric mantle beneath the southwestern United States, *Nature*, 411, 69.
- Lee, C.-T., Yin, Q.-Z., Lee, T.-C., 2001, An internal normalization technique for unmixing total-spiked mixtures with application to MC-ICP-MS, *Computers and Geosciences*, 27, 577.
- Lee, C.-T., Yin, Q.-Z., Rudnick, R. L., Chesley, J. T., Jacobsen, S. B., 2000, Os isotopic evidence for Mesozoic removal of lithospheric mantle beneath the Sierra Nevada, California, *Science*, 289, 1912.

MYRES conferences

Scope

The design of *MYRES* draws on the experience of established meetings such as the Gordon Research Conferences or summer schools such as those held in Erice, Sicily. *MYRES* meetings with their focus on bringing junior people together to tackle an interdisciplinary problem are, however, unique in that they serve several purposes:

- *MYRES* workshops are part of a larger vision of a grass-roots community building effort in the Solid Earth Sciences. *MYRES*' website with online reference material and discussion forums will be our first attempt to broaden the impact of each meeting, and to foster communication and review of instruction, research and conference objectives among the wider community.
- *MYRES* workshops are summer-school type educational efforts, where junior experts from different fields convene to explain the constraints and issues involved in their discipline's contribution to the larger problem at hand. The breadth of peer-reviewed instruction will be a great resource and go far beyond what individual university departments can typically provide.
- *MYRES* workshops will stimulate open discussion and facilitate the formulation of future collaborative research efforts and so advance Solid Earth Sciences.
- *MYRES* will provide younger researchers with a community of peers from which to draw on and with which to communicate beyond their traditional limits.

We are aware of two meeting series in the Earth Sciences that are aimed at junior researchers, the Physical Oceanography Dissertation Symposium (PODS¹) and the Atmospheric Chemistry Colloquium for Emerging Senior Scientists (ACCESS²). Both meetings are aimed at bringing together recent PhDs to foster future professional relationships, in the case of ACCESS with explicit participation of representatives from funding agencies. We do not know of any such effort in the Solid Earth Sciences. While *MYRES* is, like those workshops, intended to serve as a community building tool, *MYRES* will, unlike those meetings, also have an additional educational focus on a well defined scientific problem, with quality controlled instructional material as a tangible product. We note in passing that *MYRES* is decidedly not meant to be a job-market initiative; on the contrary, it is an attempt to disconnect from the politics of a scientific career temporarily and focus on the science itself in a cooperative environment.

MYRES workshops will be held once every two years, addressing varying interdisciplinary themes from Solid Earth for ~4 days during an extended weekend in the late summer. Provided funding for this proposal in the fall of 2003, an ambitious but possible starting date would be 2004, else the first meeting would be held 2005. Starting in 2004 would allow us, for example, to be out of phase with the Gordon Conference on *The Interior of the Earth*; we intend to complement rather than replace the current crop of conferences.

¹<http://www.pods-symposium.org/>

²<http://www.ecd.bnl.gov/accessVII.doc>, visited 06/29/03

Location

With *MYRES*, we will put the funding emphasis on support for travel and attendance costs for every participant and try to save on expenses for accommodations and conference site. We will cut overhead costs as much as possible to achieve this goal. For instance, a summer date will allow us to book college dormitories, reducing the cost of accommodations. A budget which is based on estimates we requested from several institutions in New England is detailed in the budget justification. We will hold the first meeting in the Northeastern US to reduce travel costs for European and US researchers, but future meetings could be held at sites more convenient for a different cross-section of the community. Specifically, future *MYRES* meetings might alternate between an European and an Eastern US location to facilitate the cross-Atlantic exchange. To this end, we have already had a positive initial response from an European agency, the private *VolkswagenStiftung* foundation of Wolfsburg, Germany. If NSF funding can be allocated, we will submit specific proposals to the European Science Foundation, the *VolkswagenStiftung*, and the British Research Council to support European participants. A co-financing scheme between NSF and European agencies might be established eventually.

An alternative suggestion as to the place to hold *MYRES* is to choose an US west-coast location (e.g. UC Berkeley's C. Kerr Campus or a Washington State college), and to bring in participants from the Pacific rim, possibly with the support of Australian and Japanese funding agencies. As outlined below, each *MYRES* conference will be organized by two elected chairs who are responsible for setting the conference theme, organizing the workshop, inviting conveners, and publishing conference proceedings as well as evaluating the performance. By having such a rotating chairmanship we intend to maintain flexibility in terms of the subject of *MYRES* as well as the site location, while having institutional memory by means of a semi-permanent senior faculty advisory panel as specified below.

Format

Each conference's attendance will be limited to ~ 75 people including ~ 10 keynote lecturers who are responsible for the tutorials. We will strive to make the meeting itself and the design of the program and instructional material as accessible and transparent as possible to reach and invite the broadest cross-section of the community. Each meeting topic and a preliminary schedule will be announced about nine months in advance in *EOS: Transactions of the AGU*, on all suited emailing lists (such as those of MSA³, SEDI⁴, or SCEC⁵), and our web site, which we hope will in time become a frequently used resource in its own right. For the first meeting, we will also email Earth Science departments in the US and Europe directly such that the respective administrations can forward our announcement to students and faculty and post our fliers.

All potential participants but the instructors will have to apply to take part in the conference and send in a short (~ 50 words) description of their current research interests and state the reasons why they want to attend the meeting. This will help chairs to select a representative cross section and illustrate the range of research that is going on in the community. Chairs will make these

³http://www.minsocam.org/MSA/MSA_Talk.html

⁴<http://www.sedigroup.org/>

⁵<http://www.scec.org/news/subscribe/index.html>

statements available to the instructors six months ahead of time as a help for designing the detailed program. We will also ask attendees after the meeting to evaluate the usefulness of the workshop in furthering their understanding of the constraints that pertain to their research based on their initial statements of interest.

The morning program will be filled with two hour-long review lectures whose aim is to bring everybody up to speed about topics that pertain to the meeting's theme. There will be at least a half hour set aside for discussions immediately after each presentation. Lecturers are expected to refrain from presenting only their own current work but should focus on communicating an insider's view as to why their part of the community thinks the way it does at the moment, and how different pieces of the multi-disciplinary puzzle fit together. An important outcome will be a better understanding of data and constraints each discipline provides on the problem in question. We think that it will be important to have primary source material available for the tutorial sessions for each discipline, and intend to recommend a reading list of ~5 important papers each as suggested reading. The respective list of references will be distributed in advance, and as a photocopied reader, for which reproduction permission will be requested from the copyright holders, during the conference.

The morning tutorials form an integral part of *MYRES*, and their preparation will require significant effort from the speakers. However, we think that this effort will pay off in the short term for both speakers and attendees and also contribute to our long-term educational impact, as outlined below. To ensure a high quality instructional program, keynote lecturers will meet well in advance of the meeting (~ 3 months) to agree on a comprehensive and well-rounded curriculum, to commit to presenting certain topics that will complement each other, and to review each others lecture slides. We include a request for funding a weekend recess in the spring preceding the meeting for keynote lecturers to facilitate the preparation of the program.

After the morning presentations, smaller groups will be able to meet during the afternoon in dedicated meeting rooms to explore sub-topics, specific problems, or methods in greater detail, possibly guided by the presenters and conveners of the morning. This will serve to shrink the conference and encourage participation by less vocal conferees. Depending on the topic of the meeting, afternoon sessions could also entail hands-on exercises and mini-workshops on computer tools and data analysis. However, in the spirit of the Gordon Conferences, the majority of the afternoon will be left open for informal discussion and socializing.

Evening sessions will include individual poster presentations of attendees, if appropriate, but will focus on an open discussion of the issues that were brought up during the day. These sessions will be moderated by a panel composed of the morning's speakers. Communal sessions will re-address how findings from different fields have been integrated so far and how novel avenues of research could be stipulated. The sessions will also provide a forum for discussion of the attendees' research, but monopolization of the proceedings by a select few will be actively discouraged by the panel. All attendees will, however, be expected to give a micro presentation (~3 min) in one of the evening sessions. These presentations will entail showing one overhead and describing the questions they wish to address, or the current state of their research. The aim of these micro-presentations is to stimulate an active involvement of every attendee, to introduce each participant to the group, to get an overview of what different members of the community are working on, and to give students a chance to practice communicating their agenda clearly in a limited time.

After each *MYRES*, a short write up of the major outcomes of the meeting in terms of discus-

sions will be published in *EOS* and on the web. More importantly, all instructional material will be made available online. To facilitate this publishing process, all keynote lectures will have to be given as electronic presentations in either PDF or Microsoft Powerpoint format, which we will convert to HTML to create a library of portable electronic documents that can serve as a reference and will grow during the lifetime of the *MYRES* conference series. Our copyright policy for use of the online conference proceedings will allow free classroom and scientific usage (registration with the current chairs or the *MYRES* office will be encouraged), while other usage will require the prior approval of the lecturer or original scientists.

Organizational structure

Each *MYRES* will be organized by two chairs who have a two year tenure; they will decide on the meeting's theme and topics and will, importantly, be in charge of enforcing *MYRES*' spirit and adhering to the ideas set forth in the *MYRES* proposal and manifesto. Their tasks include selecting a conference site, administration of the meeting's funds, organizing the instructor's recess, organizing the meeting, conducting and analyzing exit and follow up surveys, and supervising updates of the *MYRES* web-site. Meeting chairs will not convene sessions, but will pick discussion leaders from different disciplines for each day. With their specialist knowledge, these conveners can then either select keynote speakers or give the review lectures themselves.

The first proposed *MYRES* meeting will have a deep Earth theme (see below) but the scientific focus for each conference will be chosen anew from within the range of issues arising in the solid Earth Sciences. While the topic of each *MYRES* meeting will have to be sufficiently interdisciplinary and be of general importance to draw a wide range of attendees, it should also be focused enough so that a comprehensive exploration of the constraints and issues at stake can be achieved in four days. We will aim to establish a fully democratic process with unrestricted submission of conference proposals and a voting scheme after the initial two *MYRES* meetings. For the followup meeting after the initial deep Earth *MYRES* we will, however, focus on a crustal dynamics/plate boundary theme (see, *e.g.*, appendix A) to make sure the initial two *MYRES* conferences reach as wide a cross-section of the solid Earth community as possible.

Community involvement and operational procedures

Following the open and grass-roots philosophy of *MYRES*, we aim to eventually have the community as a whole be involved in the development of new meeting topics. In this spirit, the first meeting program and personnel list was drafted after consulting with many junior and senior members on a previous version of this proposal which we sent out by email in the spring of 2002. We furthermore presented and discussed the *MYRES* concept at the NSF sponsored CIDER workshop (Pt. Reyes, CA, May 2003).

After another informational gathering at the Gordon Research Conference on *The Interior of the Earth* (South Hadley, MA, June 2003), we formed the *MYRES Steering Committee*, which contributed to this proposal and holds joint authorship. The committee consists of Thorsten Becker (University of California, San Diego), Magali Billen (University of California, Davis), James Kellogg (Harvard University), Jeanne Hardebeck (USGS Menlo Park), Cin-Ty Lee (Rice University),

Laurent Montesi (Woods Hole Oceanographic Institution), Wendy Panero (University of Michigan), Frederik Simons (Princeton University), and Shijie Zhong (University of Colorado, Boulder). Their letters of support are included.

Various versions of this proposal were furthermore posted on the *MYRES* web page⁶ to invite comments. This proposal incorporates the suggestions of the community if they were unambiguous, but necessarily has to reflect our choices after deliberation of the pros and cons, if different alternatives were suggested.

If we obtain funding for this proposal, we will strive to broaden the range of researchers involved in *MYRES* beyond that accessible to us right now. We will announce a request for proposals for the second *MYRES* meeting in *EOS* and on the *MYRES* web site. However, we will initially restrict themes for *MYRES* II to be from outside deep Earth research, such as the example followup meeting on plate boundary processes outlined in appendix A. The function of the *MYRES* website for this competition is to create an online forum for the exchange of ideas and suggestions for current and future meetings to allow for a flexible institutional structure and a self-organized review process. We will experiment with having an informal online voting system to judge the interest of the community in specific future *MYRES* meeting topics.

The first meeting should be considered a pilot project; we will critically evaluate *MYRES*' format and the self-organizing mechanisms for future meetings. Below, we list the suggested personnel involved in the first meeting, including the list of conveners and keynote lecturers who have agreed to take part in the first *MYRES*. An integral part of *MYRES* will be the evaluation of each conference and the progress of the conference series by means of exit and follow-up surveys, as detailed below and in appendix B. The results of these surveys will be accessible online, and we intend to extensively use the feedback we get to learn from this experience and improve the second workshop. We will aim to demonstrate the usefulness of *MYRES* and intend to establish a long-term conference series by reapplying for funds after the initial two meetings have been conducted.

Timeline

Specifically, here is an ambitious schedule illustrating the aforementioned procedure assuming this proposal gets funded in the fall of 2003:

Nov. 2003: Chairs and *ad hoc* steering committee finalize the conference site and date. Chairs and committee announce the first workshop and program in *EOS*. Email announcements are sent out to mailing lists and Earth Science departments to request applications for the first meeting. The initial announcement in *EOS* will also serve as a *MYRES* manifesto that spells out the goals of the conference series as ideas to which future meetings will have to adhere.

Dec. 2003: Chairs and instructors meet informally with the senior advisory panel at the 2003 fall AGU meeting to discuss the scope of the meeting and logistics.

Feb. 2004: Chairs evaluate applications, distribute them to instructors, and organize instructor's recess. By making the greatest possible use of electronic communications, we intend to lessen the workload implied in these and similar tasks.

⁶<http://www.myres.org>

- Mar. 2004:** Instructors meet, decide on reading list, prepare instructional material, make draft lecture notes available on the *MYRES* website, and give reading list and finalized program to chairs for electronic distribution to meeting attendees.
- Aug. 2004:** First *MYRES* meeting is held. Chairs organize meeting, evaluate questionnaires, collect lecture notes, and prepare a report to be published in *EOS* in the late fall of 2004. Chairs, with the assistance of a temporarily employed undergraduate, continuously update the *MYRES* website.
- Jan. 2005:** Chairs announce a call for proposals for the next *MYRES* meeting (to be held in 2006). Conference proposals will have to include nominations for two new chairs, and program drafts. Proposals will be posted as they arrive to invite comments which will be relayed to the authors of the proposals. In the first funding cycle of *MYRES*, we will require submissions for the second *MYRES* to cover a topic outside the deep Earth, in order to widen the range of possible first time attendees.
- Aug. 2005:** Chairs publish all final competing proposals on the *MYRES* website and call for an online vote. All students and junior faculty in Solid Earth Sciences will have one vote, and voting will be electronically. Chairs, with the help of the undergraduate employed to maintain the website, will perform a rough check of eligibility as far as resources permit.
- Sep. 2005:** The old and new chairs announce the winning new meeting theme and invite applications for the second *MYRES* workshop.
- Dec. 2005:** Old and new chairs as well as new instructors meet with the senior advisory panel at the fall 2005 AGU meeting to exchange insights into running the meeting, and work out program specifics.
- 2006:** Procedure from above for the 2004 *MYRES* meeting will be repeated. After evaluation of the second meeting performance in the fall of 2006, old and new chairs will meet in the fall of 2006 AGU meeting to discuss a possible modification of *MYRES* procedures, and submit a proposal for renewed funding.

We envision running *MYRES* for the intermediate future according to these loosely formulated rules; adherence to the spirit behind the *MYRES* effort is more important than specific bylaws. Funds will be made available to the first and second meeting chairs by the PI of this proposal, and the chairs' and each meeting's performance will be continuously monitored and reviewed by the community at large.

Senior advisory panel

To provide for institutional continuity and memory while having rotating chairmanships and a grass-roots structure, *MYRES* will have a semi-permanent advisory board of ~6 senior researchers (*i.e.* tenured faculty) from across disciplines. These senior advisers will attend *MYRES* conferences to act as scientific council and reference, and to guide the chairs in logistic issues if needed. Senior advisers have, however, no other active role in the proceedings. *MYRES'* chairs and instructors

will meet briefly with the advisory panel before each *MYRES* to discuss specifics of the planned meeting, the scope of the sessions, and administrative questions. A forum for this could be a short get-together at the AGU meeting in the fall before the next *MYRES*.

The ideal candidates for the senior advisory panel should have a sincere interest in supporting the development of young researchers and in helping in the establishment and reinforcement of multidisciplinary research strategies. They would have to be willing to spend four days at each meeting, serve as council, institutional memory, and briefly meet with designated meeting chairs at the fall AGU meeting preceding the workshop.

The following senior researchers have expressed their support for *MYRES* and are willing to act as council to *MYRES*' chairs (see the appended letters of support):

- core dynamics: Bruce Buffett (University of Chicago)
- crustal/lithospheric dynamics: Leigh Royden (MIT)
- mineral physics: Donald Weidner (SUNY Stony Brook)
- geochemistry: Roberta Rudnick (University of Maryland)
- geodynamics: Richard O'Connell (Harvard University)
- seismology: Karen Fischer (Brown University)

Not all panel members will have to attend each meeting, as not all *MYRES* topics will fall within their scientific interests.

Education and community outreach

The morning review lectures are an integral part of *MYRES* and will be of great educational value for both the attendees and the speakers. While the educational component will not necessarily be better for *MYRES* just because instructors are more junior, we will attempt to provide enough incentives and an additional layer of peer-review for lecture materials to attain quality teaching. Furthermore, junior people can be expected to be better able to relate to the problems that might arise in the understanding of the issues, having themselves by necessity only comparatively recently understood the relevant problems and mastered conceptual hurdles. The instructors themselves will benefit from the preparation for *MYRES* as they will have to make an effort to communicate ideas across different fields, a skill whose mastery is rare and of great value.

Quality controlled instruction

We plan to focus on themes more than disciplines, and to broadly educate each other. It will therefore be helpful that speakers design their presentations after consulting with each other. The weekend recess for instructors is intended to provide a forum for this exchange, and help the presenters to work out a comprehensive and well orchestrated program. The workshop recess will also be dedicated to the preparation and revision of instructional material such as lecture slides and other visuals.

We will stipulate the inspection of each presenter's preliminary slides and figures to ensure quality of instructional material by an informal peer-review process among the presenters. Draft lecture outlines will also be made available on the *MYRES* website in advance of the meeting to allow input from the wider community. The tutorials and their preparation itself should already encourage cross-disciplinary communication in top-down as well as bottom-up modes.

Additionally, the instructors will use the weekend recess to decide on a reference list of ~20 key papers, selected from each discipline's contributions to the meetings topical issues. This reading list is also to be distributed electronically ahead of each meeting, and we will hand out a reader with these papers at each workshop. If copyright restrictions can be adhered to and logistical problems overcome, we will also distribute electronic versions of the articles themselves ahead of time in case an attendee's library does not hold individual journals.

***MYRES* online resources**

From the contributions of the keynote speakers in the form of electronic presentations, *MYRES* chairs will prepare an online conference-proceedings volume that will entail all of the keynote lectures and extended abstracts from each of the educational talks. All documents will be distributed electronically and free of charge from the conference web site. In this way, we should be able to establish a comprehensive and detailed reference volume on the topic treated in each *MYRES* without the publication costs of conventional printed proceedings. Conference notes will additionally be published in *EOS* to disseminate discussions and conclusions beyond the circle of attendees. The proceedings volumes will present an invaluable resource and reference for a wide range of topics beyond the reach of textbooks and lecture notes.

The instructional material will form an integral part of the documents that are available online. Besides putting all presentations on the web, we will encourage presenters to write ~ 3 page extended abstracts in a format similar to *Enhanced Science Perspectives*, which would allow the inclusion of links to additional instructional material, data, tools, or meta-data sites to back up the major ideas lecturers want to convey with their presentations. Given the proposed change of topics between each *MYRES* workshop we can expect that over time, a database of lecture notes of controllable quality will become available for the broad community in this way.

The second function of the *MYRES* web site will be as a community discussion forum for the *MYRES* workshops.⁷ We already mentioned that we are planning to have web submission and discussion of suggested programs for future *MYRES* meetings online, and an electronic voting system. We will furthermore publish the results of our questionnaires to make the evaluation of the conference performance as transparent as possible. To assist meeting chairs with these tasks, we apply for one week of undergraduate assistant support to maintain the web page.

Our long-term vision is to expand the functionality of the *MYRES* web site further to serve as a general community forum, guided by our goals of fostering an open, unbiased, and inclusive approach to science. A number of similar community sites are already available but those usually focus on specific research problems, such as the RIDGE⁸ or MARGINS⁹ web sites. These sites

⁷In that spirit, www.myres.org, already allows open discussion of *MYRES*.

⁸<http://ridge2000.bio.psu.edu/>

⁹<http://www.ldeo.columbia.edu/margins/Home.html>

realize some of the resources we want to implement for *MYRES*, and we will try to build on the lessons learned from those and similar efforts.

Among the rather easily realized services of the *MYRES* website will be an address database of junior researchers analogous to the AGU member directory, a set of links and descriptions of funding agencies and programs, and similar meta-data that can be useful for all members of the community. Among our more ambitious and work-intensive goals is the publication of quarterly online newsletters where we advertise to the community relevant funding and policy news, *MYRES* news, but also personal messages of recent graduations, new job appointments, etc., in the fashion of an alumni news magazine. We also envision an experimental, general mailing list where one can post requests for collaborators or cross-disciplinary scientific advice. This list would be managed and moderated, so that only relevant and suitably formatted messages could be posted, and would be archived by theme, as in a user forum such as the ones used for the distributed development of open-source software.

Evaluation and accountability

We intend to establish a formal review system to judge the performance of the conference series by evaluating the participants' experience. Surveys will assess the conference's format, organization, quality of instruction, topical choice and program, and effectiveness in terms of stimulating discussion and generating ideas for future collaboration. We will distribute questionnaires both immediately after the conference and after a period of six months to evaluate the anticipated long-term impact, such as actual new collaborations. We also expect that the advisory panel will offer constructive criticism during and after the conference. The results of these surveys will guide us in the design of future *MYRES* meetings.

Appendix B has a draft of a list of questions that will have to be answered by all attendees to judge the individual conference's performance while impressions are still fresh. Results from these surveys will be evaluated by the current chairs of *MYRES* and an anonymized summary result will be published on the conference series' web-site to make the performance assessment as transparent as possible. To facilitate the evaluation procedure, we intend to distribute the questionnaire electronically. *MYRES* meeting budgets and running organizational costs will be listed publicly. These questionnaires should be interpreted as a statement of our goals as well as the criteria on which we intend to be judged when applying for longer-term funding of this program.

Funding

We apply for two initial funding cycles at ~\$62k each (see budget justification). We think *MYRES* should be supported not as a general conference but as a combination of a long-term educational effort, meeting series, and a program that results in a tangible structure for the dissemination of scientific progress. With such funding, *MYRES* will aim to cover most costs for accommodation and travel expenses for all participants. We believe this is important so that conference attendance is not tied to the individual advisor's consent or attached to PI-rights. We will aim to reduce the on-site costs as much as possible, forgoing lavish accommodations so that we can achieve a broad attendance base that is not limited to privileged departments. All participants will, however,

have to pay a token fee of \$99 to avoid the possibly detrimental effects of an all-free event on the expectations of everybody involved. The \$7,425 raised from the participants' contributions in this way will be used to pay for miscellaneous expenses (computer parts, last minute costs, supplemental travel support for European keynote lecturers, etc.), any surplus will be reinvested in the long term efforts of *MYRES* (e.g. web site maintenance). The additional income from the token fees is not reflected in the *MYRES* budget justification. We should be able to achieve the goals of funding housing, food, and travel expenses for 75 participants at a rate of ~\$710/person/meeting.

Summary

We are confident that *MYRES* will provide a unique opportunity for independent and critical discourse and a setting that will allow new ideas and research strategies to flourish. Junior members of the community will be able to interact with a larger pool of peers more quickly. By educating each other across disciplines, we can achieve a better understanding of the nature of constraints and possible solution strategies for fundamental problems in the Earth Sciences. This grass-roots community building effort will help to make better use of tools and data and so improve the efficiency in turning scientific resources into an improved understanding of how the Earth works.

Acknowledgments

We have greatly benefited from the feedback we got from several junior and senior members of the community on an earlier version of this document, and from discussions during the NSF sponsored May 2003 CIDER workshop in Pt. Reyes, CA, as well as the June 2003 Gordon Research Conference on *The Interior of the Earth*.

Conference program for *MYRES I*

Heat, Helium, Hotspots, and Whole Mantle Convection

This outlines the proposed program and personnel for the first *MYRES* conference to be held in August 2004 at Smith College, Northampton, MA, on the topic of "Heat, Helium, Hotspots, and Whole Mantle Convection".

Personnel

Two coauthors of this proposal, James Kellogg and Thorsten Becker, are suggested to act as the first *MYRES* chairs. A list of conveners who have agreed to serve during the first *MYRES* is as follows:

Heat and mass flux:

Jie Li (University of Illinois, Urbana Champaign) and
Sujoy Mukhopadhyay (Harvard University).

Nature of boundary layers:

Christine Thomas (University of Liverpool) and
Shijie Zhong (University of Colorado, Boulder).

Constraints on interior dynamics:

Wendy Panero (University of Michigan, Ann Arbor) and
Frederik Simons (Princeton University).

Surface observables as constraints:

Magali Billen (University of California, Davis) and
Cin-Ty Lee (Rice University).

Program

Our working title for the first *MYRES* is “Heat, Helium, Hotspots, and Whole Mantle Convection”. We envision a re-investigation of the basic principles and assumptions upon which our conceptions of heat transport in the deep Earth are based. While this topic, in a broad sense, has been the subject of many meetings over the years, many first order issues still remain enigmatic. Especially the discussion about the origin of hotspots (deep seated plume, swell-fed, or crustal crack) has recently been reinvigorated by new seismologic findings. We have aimed to focus on a timely, broad, important, and multi-disciplinary problem which can nevertheless be treated in a short workshop. Our goal is to achieve a comprehensive and thorough understanding of the constraints that pertain to the problem, and hopefully identify promising potential solution strategies.

Because the spirit of the conference requires the keynote speakers to build the arguments from the ground up, we are likely to expose “dirty little secrets” and hidden assumptions that are not usually discussed. We will strive to compile a list of hard and soft constraints that will have to be considered for future models of heat transport and thermal evolution of the Earth. Rather than break the program into disciplines (*e.g.*, Monday is seismology, Tuesday is geochemistry, etc.) we will break the program into basic questions, then ask what data or models can be used to address them.

For example, we can ask the fundamental question “What is the thermal history of the Earth’s core?” Constraints come from a number of different fields. First, we can investigate the evidence that the Earth’s magnetic field existed, and was basically di-polar, throughout most of Earth’s history. The magnetic field requires a buoyancy source, either thermal or compositional. A consideration of the buoyancy source prompts a discussion of the age of the inner core, a question which may require some discussion of dynamo theory. Obvious trade-offs exist with potential concentrations of heat producing elements in the outer core. Addressing this issue requires an understanding of the partitioning of thorium, potassium, and uranium into the metal phase during core formation. This discussion then feeds back into considerations of the noble gas budget of the Earth.

After understanding the constraints on the heatflow out of the core, we can consider the modes of transport of heat through the mantle. For this, an understanding of thermal boundary layers, transport scaling, parameterized convection models, and fully self-consistent convection models with sophisticated rheologies is needed. A re-examination of the paradigm that there is a plate-scale mode of mantle convection, and that there is a plume-scale will be useful, and will lead to an estimation of the buoyancy flux as it is estimated from hotspot swells. Finally arriving at the

surface, we can examine the role of elastic flexure and alternative explanation for hotspot tracks. For the mantle part of the problem, global and regional constraints for the actual structure comes from seismology, and we will explore uncertainties in the techniques and the interpretation of velocity anomalies.

This back-and-forth between the disciplines will require a great deal of coordination between the presenters. We see this as one of the great challenges and potential benefits of this conference; the cooperative effort of assembling the keynotes will foster new lines of communication and greater inter-disciplinary understanding.

The themes for each of the four days with preliminary assignments of speakers are:

1. Fluxes of heat, mass, and isotopes over time (J. Li and S. Mukhopadhyay)
2. The core and the lithosphere: nature of the boundary layers (C. Thomas and S. Zhong)
3. Constraints on the interior dynamics of the Earth (W. Panero and F. Simons)
4. Surface observables and putting constraints to good use (M. Billen and C.-T. Lee)

A preliminary list of the major questions and sub-questions that ties these themes together and will have to be addressed follows.

- What is the thermal history of the core?
 - What is the evidence for a long-lived di-polar magnetic field?
 - What are the requirements for buoyancy forces?
 - What constraints do these requirements place on the history of the inner core?
 - What are the concentrations of heat producing elements in the core?
 - What is the nature of heat transfer across the CMB?
 - How would this be affected by a deep enriched layer?
 - What role (if any) does radiative heat transfer play?
 - What fraction of the heat from the core is carried in plumes versus plate-scale flow (*i.e.*, are there surface observables that constrain the heat flux across the CMB)?
- What are the number and nature of boundary layers in the solid Earth?
 - What are the current mass balance constraints provided by geochemistry?
 - Upon what observations are these constraints based?
 - * Is the entire noble gas argument built on one measurement of outgassing rates at ridges?
 - * Is the “Earth as C1 Chondrite” model still satisfactory for relative abundances of refractory elements?
 - * What is the composition of the sub-continental lithosphere?
 - How do the mechanisms of heat and noble gas transfer across boundary layers differ?

- Can thermal coupling explain the observations interpreted as slab penetration into the lower mantle?
- To what extent should tomographic inversions favor complexity in the boundary layer regions?
- What physical parameters affect the degree of entrainment across the boundary layers?
- Is the spectrum of seismic tomography indicative of the convective state of the mantle? What does the focusing of power in the boundary layers tell us?
- What is the nature and role of D''?
- How can we describe the time dependence of heat transport in the earth?
 - parameterized convection models
 - * rheology of the mantle
 - * viscous bending leads to modified dependence of heat flux on Rayleigh number?
 - * HAL layers and heat transport
 - heat transport in 2D and 3D thermal convection with temperature and stress dependent rheology
 - thermo-chemical convection
- What are the surface observables of heat transport?
 - plate cooling and half-space models, small scale convection
 - passive spreading argument based on dynamic topography
 - review of buoyancy flux at hotspots from plumes
 - alternative explanations for hotspot chains
- What is the resolution of tomography with respect to mantle structure?
 - discussion of depth and lateral dependence of different seismological datasets
 - damping and parameterization of tomographic inversions
 - thermal vs. chemical heterogeneity in joint *S* and *P* wave models
 - convergence to large scale structure?
 - spectral heterogeneity from tomography and convection models
 - new images of hotspots from regional studies and advanced inversion modeling approaches.
- What are the implications of velocity anomalies as imaged by tomography?
 - Which partial derivatives of elastic and thermodynamic properties with respect to temperature, pressure, and composition are known?
 - What mass flux can be inferred between reservoirs, if any?
 - For a given convective planform, what mixing between geochemical reservoirs can be expected?

Appendix

Future meeting topics

We have spelled out how future meeting programs and chairs will be selected by a community review in the main body of the proposal. During the numerous discussions that led to this proposal, we have become convinced that there is sufficient interest in the broader Solid Earth community to run fruitful workshops on a range of interdisciplinary problems.

As an example for a potential second *MYRES* meeting, we include a draft outline prepared by Jeanne Hardebeck (U. S. Geological Survey) and Laurent G. J. Montési (Woods Hole Oceanographic Institution) on the behavior of lithospheric plate boundaries. This agenda is only preliminary. It will be updated using three sources of input:

1. Community input by means of the *MYRES* website: Each interested young scientist will be welcome to propose amendments to this program before the second meeting is finalized.
2. Evaluation of the first meeting: suggestion to improve the meeting format will be taken into consideration.
3. Daily conveners: a convener will be selected for each day. That person will be allowed to adjust the program of the day, as long as it follows the general outline of the meeting.

Understanding the dynamics of the lithosphere: Multidisciplinary approaches to the behavior of plate boundaries

Earthquakes put much of the world's population at risk but remain the most unpredictable natural hazard. Repeated fault motion during earthquakes is also a major tectonic agent, building much of Earth's relief and accommodating at the surface the convection current from the interior. Earthquake seismology and tectonics represent two end-member aspects of fault mechanics, one focusing on the short-term and the other on the long-term aspects of plate boundary behavior. Both are the focus of much geophysical research, in the U. S. and abroad. Most researchers concentrate on one of these topics, with only a vague awareness of the advances made in the other field. *MYRES* is the perfect forum for forcing a collision between these fields. Dedicating the second meeting to plate boundary mechanics will forge a new generation of Earth scientists able to address both short-term and long term fault behavior, to tackle fundamental geological problems as well as problems of great societal importance.

Jeanne Hardebeck (currently a Mendenhall postdoctoral fellow at the US Geological Survey) and Laurent G. J. Montési (Assistant Scientist at Woods Hole Oceanographic Institution) have expressed interest in co-chairing a second *MYRES* conference on Understanding the dynamics of the lithosphere: Multidisciplinary approaches to the behavior of plate boundaries. They envision a meeting of young scientists investigating plate boundary mechanics from a broad range of perspectives, including seismology, tectonics, geology, geodesy, geodynamics, geochemistry and laboratory experimentation. This meeting will give participants a more thorough understanding of each of these fields, and facilitate new collaborations.

To foster interdisciplinary interaction, major questions will be organized not by discipline, but by topics related to the physics of deformation. In the preliminary meeting agenda, the first day introduces the topic by presenting the structure of the lithosphere, particularly in plate boundary regions. The second day addresses the mechanisms by which the lithosphere deforms, covering both brittle and ductile deformation. The third day is devoted to the dynamics of plate boundaries, from the short-term behavior during earthquakes to the long-term behavior of the development and evolution of fault systems. The final day focuses on the strength of the lithosphere and the origin of applied stresses. At the end of the meeting, both earthquake physicists and tectonicists should have a better grasp on the physics of plate boundary deformation and the interaction between earthquakes and tectonics.

A preliminary agenda for the second *MYRES* meeting is as follows. For each day, five questions are identified. It will be the (sometimes arduous) task of the invited speakers to review a particular topic, having in mind to answer these questions.

- Day 1: Structure
 - What is the composition and structure of the lithosphere?
 - What is the relationship between the different definitions of the lithosphere?
 - What is the lithospheric structure of plate boundaries?
 - What is the composition and structure of brittle fault zones?
 - What is the composition and structure of ductile shear zones?
- Day 2: Deformation Mechanisms
 - What are the differences between regions of localized and distributed deformation?
 - What is the relationship between brittle and ductile deformation?
 - What are the frictional/constitutive properties of faults?
 - What fluids are present, what is their origin, and how do they affect deformation?
 - What is the interplay between magmatism, seismicity and tectonics?
- Day 3: Dynamics
 - What controls the location, timing and slip distribution of earthquakes?
 - What causes aseismic slip and slow earthquakes?
 - What is the origin of aftershocks and postseismic deformation?
 - How do faults interact in the short- and long-term?
 - How do new faults and plate boundaries form, and how are old ones reactivated?
- Day 4: Strength and Driving Forces
 - How strong are faults, and how do they affect crustal and lithospheric strength?
 - What stresses act on a fault before/during/after an earthquake?

- How do fault strength and plate boundary strength evolve over time?
- How strong are stable plate interiors versus active plate boundaries?
- How does the strength of the lithosphere compare to driving forces?

Conference evaluation

Initial evaluation

The following is a draft of the exit survey to be filled out by all participants directly after the conference.

MYRES Exit Questionnaire

The following questions are to be answered before leaving the conference. Please answer them as truthfully as possible, as your responses will be invaluable in improving later iterations of this conference. For each of the following statements, please quantify your agreement on a scale of 1 – 5 (1 =Strongly Disagree, 2 =Somewhat Disagree, 3 =Ambivalent, 4 =Somewhat Agree, 5 =Strongly Agree).

General Impressions

1. This conference serves a unique purpose not met by other available meetings. _____
2. I would attend this meeting again in two years (assuming the subject matter were appropriate). _____
3. I would recommend holding this conference again. _____
4. There was a good balance of work and social time. _____
5. The scientific goals of this meeting were clearly defined. _____
6. I felt more comfortable speaking out at this conference than at others I have attended. _____
7. This conference was more valuable to me than others I have attended. _____
8. The expectations I had specified in my initial statement of intent were met. _____

Keynote Lectures

1. The keynote lecturers were knowledgeable and well-chosen. _____
2. The lectures were accessible. _____
3. The lectures had sufficient depth. _____
4. The lectures stimulated discussion. _____
5. The lectures adequately prepared me to follow the evening discussion. _____
6. The lecturers avoided highlighting their own work at the expense of the broader field. _____
7. I would recommend maintaining the tutorial format. _____

Evening Discussions

- 1. The evening discussion was enlightening and lively. _____
- 2. There were people actively involved in the discussion that I don't usually hear at meetings. _____
- 3. The discussion was not merely a rehash of arguments I have heard elsewhere. _____
- 4. The discussion was inclusive. _____
- 5. The discussion was accessible. _____

Small Group Discussions (if applicable)

- 1. The small group discussions were productive. _____
- 2. I formed new professional contacts with people from other fields in my group. _____
- 3. I found it easier to ask "stupid" questions in small group discussions. _____
- 4. People in my group knew their respective subjects well enough to answer my questions. _____
- 5. I have learned new techniques or gained other hands on experience. _____

Take-Home Benefits

- 1. I met other researchers with whom I expect to collaborate in the future. _____
- 2. I have a broader understanding of Earth Science as a result of this meeting. _____
- 3. I have a deeper understanding of my own subject matter as a result of this meeting. _____
- 4. I am leaving with some new ideas for projects that I may pursue. _____
- 5. I understand constraints from other disciplines for my own research better. _____

Conference Setting

- 1. The accommodations were comfortable and clean. _____
- 2. The food was edible and plentiful. _____
- 3. Travel logistics to this location were easy. _____
- 4. The lecture hall and A/V equipment were satisfactory. _____

What was the single most valuable thing about this conference for you?

If you could change one thing about this conference, what would it be?

Please feel free to add any other comments, criticisms, or suggestions below.

Follow-up questionnaire

The following is a draft of the survey we intend to conduct amongst participants nine months after each meeting to evaluate the intermediate to long term impact, specifically the success or failure in community-building.

***MYRES* Mid-Term Status Questionnaire**

We are sending this questionnaire as a follow-up to the meeting you attended last summer. Two of the primary goals of that meeting were to foster a collaborative spirit among the young research community and to generate free discussions that would lead to breakthroughs in Earth science. Your responses to these questions now will help us determine the degree to which we have been successful and how to change the meeting to better meet these goals in the future.

1. Have you started any new research project conceived, at least in part, at *MYRES*?
2. Did any new collaborations you agreed upon at the meeting materialize?
3. Were the online lecture notes accessible and of high quality?
4. Were the extended abstracts published online useful?
5. Do you plan to attend a future *MYRES* on a topic of interest to you?
6. Do you have any further ideas as to how we can improve this conference?