

NSF MARGINS Review Committee Report

Overview

The Review Committee met April 29 and 30, 2004, at NSF Headquarters to review the effectiveness and planned future directions of the MARGINS Program at the 5-year point in its history. The panel comprised individuals with a broad range of expertise, none with direct involvement in MARGINS and most with only very limited knowledge of the scope of MARGINS before beginning the review process. Our evaluation is based primarily on thorough reading of the MARGINS Program Science Plans 2004, as updated in 2003, and materials prepared by the MARGINS Office and Steering Committee summarizing science accomplishments, plans, funded projects to date, gaps remaining in the science plans not yet covered by funded research, and activities of the MARGINS Office.

The review began with presentations by NSF Program Officer Bilal Haq on the funding history and other aspects of the program and by current MARGINS Chair Julie Morris on science accomplishments and directions. Both fielded many questions and, along with other NSF program officers, remained available for additional questions later during our discussions. Bill Haxby also gave an informative presentation on the new LDEO data center that would house data from MARGINS and other programs. Our discussions and evaluation were guided by the charge to the Review Committee, which is attached as an appendix to this report. We addressed the questions in the charge as they applied specifically to each of the four separate MARGINS initiatives and to the program and its management in general. Our comments and responses to the questions in the charge are given in narrative form in the sections below. The following paragraphs give an overview and emphasize a few of the most important points.

In many ways, it is premature to evaluate the specific scientific accomplishments of MARGINS. The Rupturing Continental Lithosphere (RCL) and Source-to-Sink (S2S) initiatives are both just beginning to ramp up and some of the major experiments in the other two initiatives have just barely been completed or are just beginning the data acquisition phase. Although there have been some important, specific advances that have, for example, forced a change in the conceptual model underlying the SEIZE initiative, much of our evaluation is based on early returns from studies underway and the success of the program in funding projects that will address the key scientific questions.

The **MARGINS Program is a unique and effective approach to studying dynamic earth processes.** It draws together scientists from both the Earth science and Ocean science communities to address issues that span the ocean/continent boundaries. It is one of very few programs that derive **funding from both the Earth and Ocean Science divisions** of NSF's Geoscience Directorate, a practice that **should continue given the balance of on land and at sea efforts.** Through its emphasis on integrative science in a few focus areas, the Science Plan promises to achieve a much more thorough understanding of entire dynamic systems, such as erosion, sediment transport, storage and

deposition, than can be achieved through individual proposals in scattered areas. The Continental Dynamics Program has some of these characteristics, but doesn't have the emphasis on broad, interdisciplinary community building through workshops, development of databases, and decadal scale commitment that characterizes MARGINS. The multidisciplinary approach of the MARGINS Program provides a model for how synergistic science could be conducted in the 21st century.

The Review Committee endorses the strategy of having two end-member focus areas for each of the four initiatives, with some caveats as described below. Although different end-members could have been selected, the choices that were made are logical and provide good examples that will help understand the mechanisms that control the entire range of such systems. Given the limited resources available and the great amount of work that remains to be accomplished, the Review Committee recommends that there be **no expansion to additional focus sites at this time.**

The Rupturing Continental Lithosphere Initiative has been hampered by political negotiations on access to the Red Sea/Gulf of Suez site and by concern for the protection of marine mammals in the Gulf of California. We see no practical alternative to the Red Sea as a focus site that involves active rupturing of cratonic lithosphere with an along-strike transition to seafloor spreading. We recommend continuing negotiations for access. Until and **unless access is approved** for some of the core seismic experiments, **we recommend that the Red Sea be suspended as a focus site**; there simply won't be enough information to integrate into an overall model in the time frame of the MARGINS program. Already funded projects should be continued, but additional proposals for related ancillary work in that area should be submitted to Core Programs, because there is no viable focus at this time. There has already been sufficient seismic work performed in Gulf of California that it makes sense to continue other types of research there even if additional seismic work is prohibited. Thus, Gulf of California should continue as the sole focus site for now. If the Red Sea negotiations do not succeed in a reasonable amount of time, then MARGINS should consider the possibility of selecting a different type of endmember, such as a robustly magmatic margin, to replace the Red Sea site.

MARGINS should **work toward a balance in funding of the different initiatives.** As shown in Figure 1, the number of proposals funded in the Subduction Factory (SubFac) and SEIZE initiatives is much larger than in the other two. Total funding in a general way has paralleled these trends. Most of the imbalance is natural, reflecting proposal pressure, the earlier organization of the SubFac and SEIZE initiatives, and the restrictions that have hampered RCL. Encouraging broader participation in S2S and emphasizing the importance of filling in the scientific gaps in the focus sites should rectify the imbalance without giving preference to any one initiative in the proposal review process.

As the Initiatives mature, **increasing emphasis should be placed on integration** of the results across various disciplines, and, where appropriate, across initiatives. The ultimate test of MARGINS' success will be whether the whole is more than the sum of the parts. To bring together the diverse efforts beyond what is achieved just by concentrating them in limited geographic areas, workshops should be organized, publications planned, and

perhaps integrated modeling proposals should be solicited. The Steering Committee could play a more active role in guiding each Initiative by continuing the process of identifying both accomplishments and remaining gaps and by stimulating integrative efforts. Workshops should also try to integrate knowledge from analog sites preserved in the geological record and from other active examples of the processes that are being studied elsewhere.

Rupturing Continental Lithosphere (RCL) Initiative

This initiative has faced severe practical difficulties in carrying out some of the cornerstone experiments needed to fulfill the goals of the MARGINS program. Defining the seismic structure of the focus site is an indispensable part of this initiative. Political problems in Red Sea/Gulf of Suez have prevented the start of major passive and active seismic studies there. Issues of the potential effects of active seismic sources on marine mammals caused curtailment of Multi-Channel Seismic work in the Gulf of California. Until such critical data sets can be collected in any area, it cannot be considered a viable focus site.

We recognize that the Red Sea/Gulf of Suez is the only practical, active example of a non-orogenic area that transitions from continental rifting to seafloor spreading. Thus, we strongly encourage the RCL community to continue to vigorously pursue international negotiations to facilitate this work. If it appears that seismic work in the Red Sea/Gulf of Suez cannot be done within the decadal time frame of the MARGINS program then the RCL community should consider alternative locations for a focus site. Until viability of this potential focus site can be established, related ancillary science should be processed through the core programs.

Analogous to the Red Sea, seismic and other marine geophysical data are essential to the goal of the work on the Gulf of California orogenic rifted region. Some of the key data for this focus site have already been collected, but due to permitting problems associated with the concern for marine mammal protection, not all planned marine work has been completed. After the existing data are processed and analyzed a determination will have to be made as to whether it is sufficient, although it appears that there is enough already known to proceed with the Gulf of California as a focus site.

If the Steering Committee determines that these logistical issues of access cannot be resolved in a timely fashion, then it should open up a process of consideration of alternative sites on which to begin a new focus. If it comes to this we would recommend reevaluation of the criteria for selecting focus sites in light of new perspectives on how rifting occurs. Magmatic processes are an example of a topic that we feel could profitably be included in any such reevaluation. Since the inception of the MARGINS program, magmatism has been increasingly recognized as an important factor (e.g., magmatic vs. non-magmatic rifts and rifted margins). The volume and composition of the magma through time provides information about the mantle in the melt production region at depths of 30 to 150 km and about the evolution of the continental lithosphere during the rifting process. Attention also needs to be placed on questions revealed by

previous geologic studies, including old rifts, and on how work on the focus site bears on our overall understanding of rifting processes and diversity.

Despite the logistical difficulties encountered, we are impressed with the progress being made at the Gulf of California site. The level of concerted effort would not have happened without MARGINS. The passive seismic arrays will provide much information about anomalies in the upper mantle associated with rifting as well as gross crustal structure. Studies on land are providing crucial information about the sequence of faulting and subsidence and existing and planned seismic surveys constrain the style of rifting in different extending basins. RCL addresses fundamental questions of the processes of formation of at least half the continental margins and should be continued as an Initiative within MARGINS, even if the Gulf of California is the only focus site on which substantial progress is made within the nominal 10-year life of MARGINS.

Source to Sink Initiative (S2S)

The S2S goal of examining how externally- and internally-generated sedimentary signals are transferred across the dynamic boundaries between sub-environments in a sediment-dispersal system is seen as exciting and fundamental. The development of a Community Sediment Model is recognized as a valuable step in generalizing the results of field and experimental studies and achieving a more comprehensive understanding of the complex processes that transfer weathering products from sources areas to their ultimate resting place in sedimentary basins. The Review Committee encourages the S2S community to work diligently to achieve these goals.

The S2S sub-program is the most recently started and, hence, the least fully developed of the four components of the MARGINS program. The research plans and statements of research gaps are not sufficiently detailed to allow the Review Committee to fully appreciate how the larger objectives of this sub-program will be achieved.

The Committee was of two minds concerning the conceptual focus of S2S. The focus is narrowly geared towards flux of solids from source to the sink. The advantage of this limited approach is that the objectives may be obtainable on the time frame of the MARGINS program. However, the lack of apparent attention to the dissolved load/nutrients as well as biologic aspects was viewed as a gap in the science plan. The absence of these components means that important elements of the systems, which might act to create and/or modify sedimentary signals, appear to have been ignored.

The Committee urges the S2S community to incorporate theoretical consideration of how signals (of any kind) might be transmitted through any sedimentary system. The highly conceptual model outlined in Figure 3 of the 2004 Science Plan needs to be formalized using signal-processing theory, to provide a more rigorous theoretical basis for the ultimate integration of the information that will be obtained from the various components of the focus sites. For example, under what conditions do components of a sedimentary system act as capacitors or amplifiers? Moreover, how does relative abundance of bedload and suspended load influence the signal-processing function of a given system?

The results that will be obtained from the two focus sites will have much more universal value if they can be placed in such a theoretical framework. (It should be noted that this type of theoretical investigation should supplement rather than replace, or be replaced by, the Community Sediment Model).

In proposals funded so far, there are obvious gaps in the source-to-sink system. Besides those mentioned above, the Review Committee noted that factors responsible for the production of sediment in the source area have not yet been addressed at either site. In the Fly River system in particular, there appears to be a significant lack of information on the climatic forcing functions. There are many lakes in the study area that should contain important records of climate change, and perhaps also the possible influence of human influence on vegetation. Effort should be made to initiate research on this topic as soon as possible, so that the results can inform other aspects of the study. The shelf carbonate realm of the Fly system is also a component of the system that should be examined.

The Steering Committee could help fill in these and other gaps by drawing attention to them in a community-wide mailing. Perhaps the Steering Committees self review in preparation for this formal review could be distributed to the entire mailing list or be made available on the website and attention drawn to it through a brief mailing. The need for studies making the linkages between the discrete sectors of the dispersal system could also be promoted actively by the Steering Committee.

The focus on active processes is an important unifying aspect of the entire MARGINS program. In the S2S sub-program, the range of time scales of the processes being examined seems limited in scope. The research plan provides moderately clear goals to examine seasonal variation in the Fly system, but there does not appear to be any provision to have a rapid-response capability for cyclonic events in the Waipaoa system, similar to what SubFac did with the eruption of Anatahan. NSF funding is apparently available for such event responses and the S2S community should consider how it might usefully take advantage of this opportunity.

S2S has been formulated to cover the past 18 ka. It is evident how this will be sampled in the marine record (via CHIRP, shallow coring), but it is less clear how the equivalent time period will be examined in the nonmarine realm. Ideally similar time scales will be examined across the entire system.

With regard to system responses at longer time scales, we encourage the S2S community to integrate ideas and questions generated by the rock-oriented sedimentary community (including those in the petroleum industry). This will also have the benefit of making the ultimate research results of more directly applicable to this group of end users.

The Review Committee noted that the S2S sub-program had no direct linkages with any of the other components of the MARGINS program, despite the fact that sediments were identified as being important in many of the other focus sites (e.g., Gulf of California and in the Central America trench). The MARGINS Office has identified the potential creation of an S2S site in Nicaragua as a priority, because of its obvious and potentially

beneficial linkage with both the SubFac and SEIZE initiatives. The Committee supports this idea, but with the reservation that, with current funding levels, it may not be possible to support efforts at three locales and it is important to ensure the success of the existing sites first.

In summary, the Review Committee recognizes that the S2S sub-program is still in its infancy. In the coming years, it must make a strong effort to ensure that the necessary work is done to document all of the signal-generating processes and/or events, and to study all signal-transfer and signal-modifying components of the system. The Committee does not yet see that this overall coordination exists in either focus site. Various gaps appear to exist in the research plans, some of which are not so identified by the S2S community in the material provided to the Committee. Consideration might be paid to developing a group within the steering committee to ensure that gaps are filled and integration occurs.

SEIZE Initiative

The overlying themes of the SEIZE Initiative address fundamental issues of the earthquake generating cycle. The themes are comprehensive and ambitious, directed primarily toward the basic understanding of the processes and structures that control the spatial and temporal patterns of seismic energy release. These themes are addressed by a number of other major research efforts, both domestic and international. Coordination and communication with those efforts are essential. SEIZE makes a unique contribution in coordinating onshore/offshore investigation of subduction zone seismic processes in two endmember locations where drilling the seismic portion of the main thrust zone may be possible. A planned, organized program like MARGINS is essential for efficient progress, because international collaboration and coordination of the clear sequence of studies necessitated by culmination in drilling can best be facilitated through a central office.

The two focus sites chosen represent good end-member examples of subduction zone seismicity, one with occasional huge earthquakes and the other with more frequent, but still large events. It is not practical to expand the program to include more focus sites. Both areas have extensive, ongoing, international research efforts that make the overall research program feasible. International cooperation has been excellent.

The conceptual model that underlies the SEIZE seismic plan has been rapidly evolving. The simple concept of an updip and downdip limit to the seismic zone is being replaced by one in which there are temporal and spatial variations in slip and coupling within the seismogenic zone. The idea that the updip limit may be controlled by the smectite to illite phase transition has been obviated by laboratory investigations, and this is an important accomplishment of MARGIN funded research. Research plans and identified gaps need to evolve to reflect this evolution in the underlying model.

To date, the sequence of efforts seems appropriate. 3-D or pseudo-3-D seismic reflection experiments are being carried out to select drilling sites, and laboratory and modeling experiments are providing the basis for interpretation of the observational programs.

Two major gaps in currently funded research stand out as particularly high priorities. First, continuous GPS monitoring in Costa Rica is essential and should be begun as soon as possible. The recent discovery of transient, quiet, slip events in other subduction zones has revealed a new process in the earthquake cycle that must be monitored. Long-term, offshore seismometer deployments would complement the displacement measurements provided by GPS. Second, a new, detailed seismic reflection study is needed in Nankai to find a site suitable for drilling to the seismogenic zone.

More sophisticated thermal models incorporating fluid flow are needed for improved characterization of the thermal structure of the subduction thrusts. More attention to characterizing the spatial pattern of fluid flow and composition of the fluids may be desirable to help in constructing thermal models, understanding the nature of fluid-rock interaction, and the permeability structure of the subduction zone. Laboratory and modeling studies of physical properties and hydrologic, thermal, and chemical processes should be continued.

Although the science plan is well-designed to investigate the two focus sites, two sites are not sufficient to fully answer the overarching questions. Other subduction zones are also the subject of extensive investigation by other agencies, domestic and international, with the Cascadia subduction zone off western North America being a particularly obvious example. Comparison with as many examples as possible will be needed to test hypotheses developed from the focus sites. A workshop summarizing progress to date and involving comparison with studies elsewhere is strongly encouraged as a step toward integrating the diverse information.

It is too early to really evaluate success of this Initiative. The drilling component is years in the future and some of the seismic investigations are just completed or yet to be executed. The laboratory and modeling studies have been fruitful and overall this component is headed in the right direction. There does need to be more effective communication to the public and the rest of the scientific community about the specific ways in which the planned measurements will contribute to resolving outstanding issues in the earthquake generation process.

Subduction Factory Initiative (SubFac)

Our impression of the SubFac initiative is that it is a relatively mature effort with a clear though ambitious agenda. The organization and level of problem definition reflect the fact that this group has benefited from numerous integrative meetings and workshops. In fact, the workshops have contributed greatly to community building and effective cross-discipline communication. The SubFac Initiative's holistic approach to tracking material fluxes from trench to volcanic arc is exciting and clearly enjoying success, with a high

level of community activity and widespread interest in the results. In a sense we have the least to say about this initiative because it is doing so well.

SubFac and related proposals have met with relatively high funding success rates. This in part reflects the maturity and diversity of the community, and the cross-discipline applicability of many of the projects.

The SubFac community is addressing many intrinsically important issues, some of which are also highly relevant to other MARGINS initiatives. Examples include studies of volatile budgets, and material fluxes in general. Volatile budgets are being addressed in terms of inventories in converging plates, metamorphic devolatilization processes in subducting slabs, magmatic outputs (via gas and melt inclusion studies), and the processes and forcing functions involved in controlling these inventories.

Determinations of useful material flux estimates depend on the availability of comprehensive knowledge of arc crustal structure, and especially intrusive:extrusive volume proportions, from which magma production rates can be deduced. Problems of this type and scale can only be attacked via broad and detailed studies, and probably could not be accomplished without an initiative like MARGINS.

The focus of SubFac has the clear advantage that essentially 'real-time' observations can be linked and interpreted in terms of recent or on-going processes. However, this focus could lead to an underemphasis of historical perspectives on the tectonic and magmatic evolution of arc crust and lithosphere. Paleosubduction processes may have a cumulative contribution to modern magmatic arcs, and need to be evaluated, perhaps through "MARGINS-Related" investigations and syntheses.

We feel that SubFac effectively integrates activities within a diverse range of disciplines, and good progress has been made in identifying research problems and needs. However, it is less clear how the diverse results will be integrated in answering specific questions. In this regard, past successes need to be stressed, and guidelines established as to how integrated interpretive products will be produced in the future.

It will be useful to work toward unified models that are effective in predicting aspects of convergent margin behavior, such as controls of magma or fluid production and composition in terms of physical forcing factors. These models need to integrate the interconnectivity of arc magmatism, geodynamics, metamorphism, hydrology, etc. They should prove helpful in identifying new problems and in formulating new interpretations.

MARGINS Management and Steering Committee

The review committee discussed various aspects of the management structure of the MARGINS Initiative and related administrative and outreach issues. Overall, it is clear that MARGINS has benefited from the strong leadership of chairs Taylor, Karner, and Morris, who have worked hard to promote communication and keep the program on track.

MARGINS Steering Committee

The review committee believes that the Steering Committee has, in general, done a very good job of facilitating the development, codification and implementation of the four Initiatives through workshops and meetings involving the broad community. The composition of the committee also appears to be appropriate. Specific recommendations include the following:

1. While it is appropriate that the Steering Committee as a whole remain responsible for the proper functioning of the entire Margins Program, we also feel that the progress of each Initiative within the Program would benefit from the assignment of a sub-group of committee members to each Initiative who would assume a more focused, continuous and pro-active responsibility for the particular Initiative. We feel that by focusing responsibility on a smaller group of interested committee members, each Initiative will benefit from enhanced regular scrutiny. Each sub-group could evaluate the status of their Initiative in advance of the Steering Committee meeting, and make recommendations in their report to the Committee. We understand that there are currently approximately 12 committee members; 3 could be assigned to each Initiative. We do not recommend significantly increasing the size of the Steering Committee to accomplish this sub-group oversight.
2. The Margins Program is entering a phase in which at least one Initiative, the Subduction Factory, is reaching maturation. What appears to be lacking, however, is the hoped-for integration of the various individual studies funded under the program. One of the most important roles for the Steering Committee is to foster integration of the disparate discipline-based results. The Steering Committee should begin to plan for a synthesis workshop on SubFac results for some time during the coming year or two. We recognize that getting people to really work together across (or even within) disciplines, can be quite difficult, but the success of the Program depends on the success of this effort.
3. With respect to the composition of the Steering Committee and the way that members are chosen, we recognize the complexity of this issue and the ever-present charge that those in positions of leadership are insiders. Our recommendation is simply to try to make sure that the committee has the necessary diversity of expertise, and includes a healthy mix of established leaders, younger scientists with new ideas, those who receive funding from the program and those who do not, and also taking into account gender and minority considerations. The current procedure for selecting new members (with a widely disseminated invitation) appears to be logical.

MARGINS Office

The review committee discussed the various functions of the Margins Office and feels that it is doing a good job of disseminating information. We agreed that the Newsletter is a valuable source of information and community-building effort, as is the Website (although the latter would benefit from the development of the education/outreach effort that is apparently planned). With regard to data archiving, it is

clear that far more effective data storage and dissemination will be available through the planned LDEO data archive and possibly other resources. Ultimately, the Margins Office may have to play a role in reminding individual investigations funded under Margins to provide their data to the database.

MARGINS Data Center

The present MARGINS Metadata server has just become available. The newly funded MARGINS database housed at Lamont (Ryan et al.) provides an excellent, user-friendly shell to view digital data. It should interface well with other databases also available from LDEO and UTIG. The MARGINS data policy statement is that “expedition metadata should be archived within 60 days of the end of the field experiment, and data should be archived within 2 years.” The data policy regarding warehousing of other data sources seems adequate for the moment, as long as core archives, as an example, are available. Ideally, integration into the Lamont data server should provide a means for raw data dissemination as well as a source of processed or interpreted data for to be made available for educational purposes.

At present, there doesn't appear to be a plan for archival of raw, physical samples other than providing meta-data through the data center. Some method or archiving and distributing key samples is desirable so that other investigators could perform different chemical analyses on the same cores, for example, without having to replicate the field program or introducing uncertainty as to the similarity of the samples.

Education and Outreach

The impact of the MARGINS program can be greatly enhanced across a broad spectrum of scientists and the public. The program is viewed by some as a closed shop whose researchers are pre-selected by dint of the choice of focus sites. This view is unhealthy for the long-term success of the program. New blood and new views are needed, and future focus sites will likely change with time. The program needs to build and maintain a base of support among the broader earth science community.

The following suggestions will encourage interaction amongst MARGINS workers, promote interaction between the MARGINS program and others in the broader geoscience community and provide valuable learning experiences for secondary education. We believe such programs are needed to enhance the visibility and awareness of the program.

1. Workshops – Integration between researchers funded under sub-initiatives needs to be encouraged by periodic group workshops. These become increasingly important as site initiatives reach maturity and start to wind down, as is the case for the SubFac program. Integration of results within and among the different initiatives is one of the major challenges to the MARGINS program and workshops are one of the best ways to promote this important result.
2. Theoretical Institutes – Another way that MARGINS can reach out to the broader geoscience community, increase its visibility (and hopefully support) and bring in fresh ideas to bear on study areas is to continue to sponsor topical theoretical institutes. These conferences must be open to a broad spectrum of scientists

including those not tied to any MARGINS proposal. The idea in hosting such meetings (perhaps analogous to Chapman Conferences or Penrose Conferences) is to:

- a. Raise awareness and increase the visibility of the MARGINS program and its perceived impact on the community;
- b. Serve as an incubator for new ideas that bear in some way to the goals of MARGINS studies;
- c. Bring new researchers, particularly those just beginning their careers, into the greater MARGINS community. This will keep the program fresh, evolving, and promoting future research directions. Published volumes from these topical proceedings may be a way of further disseminating these ideas (e.g., Eiler, AGU Monograph, 2004).

3. Educational Outreach –

Thus far, little has been done along the lines of promoting MARGINS, and earth science in general, in any direct way. The explicit educational aspects of the program are just beginning to get underway. At present this part of the MARGINS website has not been developed. This is an important way to draw attention to the program and its uniqueness in integrative approach.

- a. Speakers program – we recommend establishing a MARGINS Speakers Series, akin to the ODP Distinguished Lecturer program. This is a cheap, effective way of promoting the program, and especially its message of integrative science.
- b. Support should be given for development of Web based education modules similar to that done by the RIDGE or IRIS geared towards grades 6-12 and above. This might be outsourced, but need not be if suitable personnel can be found within the office. In any case, the site should reside at some place where it is not relocated every time the MARGINS office moves so as not to lose continuity.
- c. Make available on the website collections of figures, simple captions and examples of interpreted data that could be used for presentations or for incorporation into educational materials. [These could also be contributed to outlets such as DELESE, AGI's Image Bank, etc.]

4. Newsletter – The Newsletter is attractively prepared, informative, and well-designed to communicate with the MARGINS Community. We have no data on how effective the Newsletter is as an advertising tool to bring new (non-MARGINS) scientists into the fold. We would encourage making a special effort to get graduate students onto the distribution list (possibly via an e-newspaper) to promote the program and encourage new blood.

International Participation

No MARGINS study site lies within U.S. waters. Thus, international collaborations need to be actively sought as the program continues to develop. SEIZE has been particularly aggressive in developing collaboration with Japanese and German scientists. Although other specific proposals have developed international collaborators,

the program as a whole should attempt to promote formal collaborative studies in the focus sites, possibly to the point of including international representation on the steering committee.

We note that many of the funded proposals have led to participation of graduate students from other countries, who, in a number of cases, have come to the United States for collaborative work. We encourage the continuation of these types of collaboration that add diversity and strength to the MARGINS program and our educational institutions.

MARGINS proposals: NSF review procedures

We strongly support the continued joint effort of EAR and OCE in convening a dedicated Margins panel review. This allows each proposal to be evaluated not only in terms of science but also in the context of other proposals submitted to the Margins Program. This separate review, combined with the knowledge of the NSF program managers and guiding Margins documents, obviates the need for a separate relevancy panel. Our only suggestion is that the mail reviewers be asked to also evaluate each proposal's relevancy and be provided with a Web link to succinct text that describes the program, its goals, gaps and other funded work.

Next NSF Review

In regard to how often the Program should be reviewed, it appears to us that the process of preparing for this NSF review was a particularly valuable one for the Steering Committee and others involved, requiring the collection of a great deal of information and self-analysis of accomplishments that led to clearer ideas of the remaining gaps and priorities for future work. In this sense, more frequent reviews may be valuable as the Program nears its end and more integration is needed, perhaps every 3 or 4 years.

Re-Emphasizing the Importance of Integration

A major justification for the MARGINS program is to promote integrated studies that bring information derived from a range of disciplines to bear on complex geologic problems. It is clear from the program plan that multi-disciplinary work is being pursued (at least that several disciplines are involved in each focus site). However, there is less evidence that the data from the different disciplines is in fact being integrated. The program plan does not discuss strategies or specific steps that are or will be taken to integrate the various types of data. It also does not provide many examples of integration that has already happened, as a means of illustrating the value of the multidisciplinary work.

The success, and in fact the future, of the MARGINS program may depend heavily on the ability of the initiatives to demonstrate that they have arrived at unexpected and compelling conclusions mainly as a result of the coordinated multi-disciplinary approach. If this cannot be demonstrated, then one must question the need for the program. It would behoove the steering committee to think more about how they might "engineer" real integration of ongoing projects. And it would be valuable for future panels to insist that new projects be specific about how integration will be achieved.

There are several possible models for managing integration. The Steering Committee, or subsets of the committee, could be tasked with overseeing each initiative or focus site and evaluating the opportunities for novel integration. They might also be tasked with identifying the current missing pieces or gaps, as well as coming up with strategies for integrating the various types of data.

In general, development of geodynamic models can serve as an important integrative activity. The objective in the long run is to have a predictive capability, part of which involves understanding how different boundary conditions affect the behavior of the system. On the other hand, just evaluating the level of consistency between different data sets, or between available models and data, can be illuminating. For example, the program plan shows seismic velocity cross-sections of the sub-arc mantle and numerical simulations of temperature structure on the same page. Is one predicted by the other? Where are the mismatches and what might they mean? What are the weak links in making these comparisons (minerals physics data?, distribution of fluids?, distribution of partial melts?)? Are there any two data sets from different approaches that can be considered to be consistent in the context of present knowledge? It may be that these comparisons will identify the real scientific issues and guide future research. This type of thinking would seem to lie at the heart of “integration”, but there are relatively few examples given in the plan or presented at this stage.

Planning for the Long-Range Future of MARGINS

The current MARGINS program plan has two identified focus sites for each initiative. The choice of sites is defended reasonably well. However, in the long run, there are two issues. One issue is whether there may not be other types of “margin” problems that could be addressed as part of the program. There are transform margins, for instance, as well as various other types of extensional and convergent margins. Even within the stated scientific goals of the current initiatives, there may be good reason to eventually add new focus sites. For example, within SubFac there could be added a continental margin magmatic arc site or a volcanic arc with oblique subduction like the Aleutians. For RCL, it is still unclear how feasible the current focus site choices are, at least for seismic studies. For S2S, consideration could be given to glacial settings and sites that integrate with other initiatives like SEIZE. Towards the end of the planned lifetime of MARGINS, perhaps as part of integrative workshops or Theoretical and Experimental Institutes, the community could begin to discuss "What's Next?". New sites might involve somewhat different scientific objectives, but it might be expected that the results from the current focus sites will raise questions that can be addressed only by eventually moving to another site where the “forcing functions” are different or have different values.

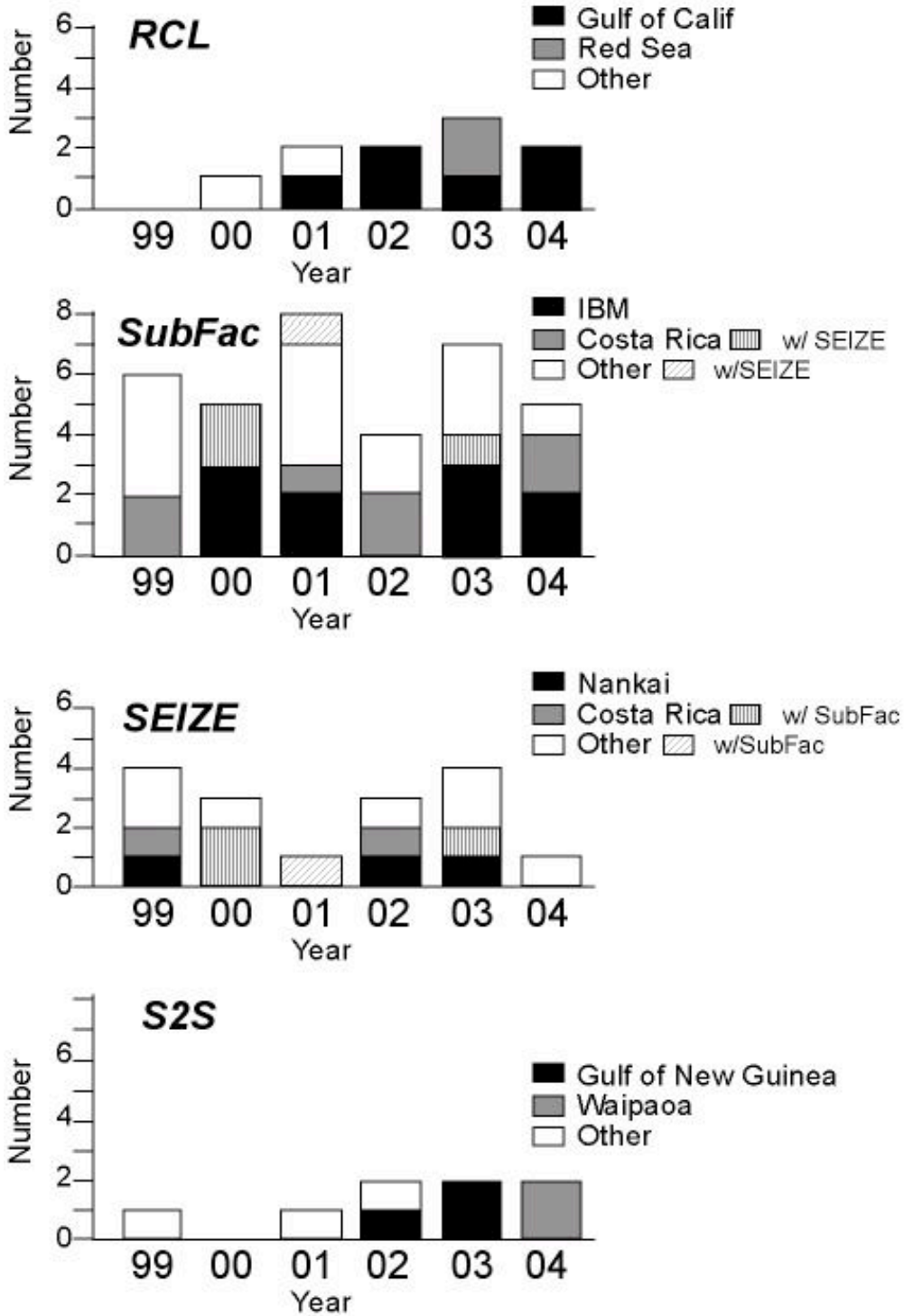


Figure 1. Funding history of MARGINS in terms of number of funded projects associated with each initiative and focus site. Other category includes general overarching studies as well as related workshops and theoretical institutes.

Appendix. Charge to the MARGINS Review Committee

Purpose:

- A. To review the MARGINS Program and provide recommendations to NSF on:
- the science directions as stated in the published “Science Plans” - are they significant and appropriate?
 - major gaps, if any, in the Science Plans for each initiative within the MARGINS Program
 - the implementation of each initiative – whether it is on schedule and sequence of undertaken research is appropriate or needs to be modified
 - the coordination and direction of the Program by MARGINS Steering Committee (MSC) - whether it has been appropriate and effective and/or can be improved.
- B. Provide advice to MARGINS research community and MSC.

Science Considerations:

1. The scientific community has identified science directions regarded as vitally important, as articulated in the science plans for each initiative. Are there additional questions that should be answered? Are there any significant gaps in these plans?
2. The MARGINS community in their early deliberations determined that since resources would not be available to carry out a full range of experiments at every potential site, they would focus on two end member scenarios at two “focus” sites for each initiative. Are these focus sites appropriate and are the stated objectives achievable at these sites? When is the work at a focus site considered complete?
3. Should any or all of the “ancillary” sites as identified by the science plans be added to the roster of the active experiments? If so, at what stage? Should geographic location or remoteness be a criterion for selecting viable ancillary sites? Should the number of “focus” sites that are active at any one time be constant? Or alternatively be linked to the NSF MARGINS budget?
4. Some “focus” sites may not be approachable in the near future due to potential political or environmental issues. Should the Program consider postponing these indefinitely and replacing them with the “ancillary” sites for those initiatives? In the case that there are no ancillary sites, thus possibly compromising the end-member concept as outlined in the science plans, what should be the future of the initiative?
5. The rationale for focused programs such as MARGINS is usually based on either the need for a large facility with a high science priority, or the need to undertake one or more compelling experiments that are too large in scope to fit within a

- normal disciplinary program. A focused program is also envisaged to engender greater multi-discipline collaboration, attract new funds, and facilitate execution of larger and better planned experiments with greater lead time that require community input via an effective steering group. Does the science defined in the published science plans for each initiative meet several of these criteria and to what extent have the experiments/projects funded so far met these criteria?
6. Given the incremental spin-up of MARGINS, what are the general impressions of its accomplishments and past productivity as a focused program within NSF/GEO? What is the spectrum of opinion in the broader community about this focused?
 7. In view of “experiments” defined under each initiative and under each “focus site”, have the appropriate “sequence” of observations/analyses been identified to achieve timely and cost-effective results? To what extent have these observations/analyses been carried out “in sequence” in the funded experiments? If not, what sequence of events would the committee recommend?
 8. With reference to item 7, are there any major disparities in effective implementation plans for each experiment to achieve timely and cost-effective results that require immediate attention and/or modification?
 9. What more can the MARGINS Program do to engender greater: multi-disciplinarity and collaboration, participation of minorities, outreach and educational opportunities, and international participation?
 10. Is the current review process of MARGINS science proposals (via a separate annual review panel) appropriate and effective or can it be improved to engender greater competition and cost effectiveness?

Management Considerations

MARGINS Office

1. Has the MARGINS Office been an effective source of communication, coordination and dissemination of results for the broader MARGINS and MG&G community? How effective is the MARGINS Newsletter? Its Website?
2. Can the committee recommend other tasks for the Office that would enhance its value to the broader marine geoscience community?
3. Currently the Office is only tasked to assimilate and publicize meta-data for each MARGINS focus site. Should the Office be more involved in MARGINS data management? Or is it more appropriate and effective to outsource the managing of the data by academic groups within the community?

4. How can the Office better achieve its outreach objectives?

MARGINS Steering Committee

1. The MSC is tasked with providing continuous advice and focus for the MARGINS Program. Its membership is voluntary and its composition largely reflects the interests of the four initiatives of the Program, with an appropriate geographical/institutional balance. Are the current tasks ascribed to the MSC (as described on the MARGINS website) appropriate? Could they be performing additional duties to enhance their effectiveness?
2. Do the MSC members effectively represent the interests of the MARGINS community? Are there concerns about an “insider” status for MSC members, and if so what steps should be taken to improve the situation?
3. Current criteria for selection on the MSC include recommendations by sitting members, invitation for self-nomination via the MARGINS Newsletter and the MARGINS website, and recommendations by program managers. Thematic balance is also an important criterion, and gender/age balance are ancillary considerations. Should protocols for member selection be changed to better serve the larger MARGINS community?
4. Are such periodic reviews (approximately every five years) of large focused programs appropriate and useful?