

Guidelines for writing successful proposals

An integral part of any geologist's scientific research is the quest for grant money. Whatever the field of research, the ability to support graduate students, conduct field work, purchase laboratory and computer equipment, and, frequently, pay one's own salary depends on acquiring state, federal, or private support. The way to get federal money is to successfully propose a research project to such federal agencies as the National Science Foundation or the National Aeronautics & Space Administration. But for many researchers, particularly those just starting, the approach to writing a proposal may be unclear, and the review process even more of a 'black box.' While serving on geology review panels, and during a year spent in Washington, D.C., as acting geology program manager for NASA's Land Processes Branch, I became familiar with the proposal and review process, and observed the following aspects of successful proposal writing.

Not all agencies have the same set of science objectives, so a proposal should be tailored for the specific program and its agency. For example, NSF is primarily interested in basic research, NASA is oriented toward space-mission research, and the Office of Naval Research prefers marine-geology investigations of the ocean environment. Each agency has a preferred format for its proposals. Specific format information and lists of submission deadlines can be obtained by writing to agency offices. Federal agencies operate on strict deadlines and late submission of a proposal can result in its rejection without review—so pay close attention to agency guidelines.

Typically, the length of the scientific part of a proposal is about 10 to 15 single-spaced pages, with appendices for budget and biographical information. Keep proposals to that length. A review panel may see 50 to 200 proposals like yours in a single week, so don't lose their interest by submitting an excessively long proposal or by adding lengthy appendices.

The review process can take 9 to 12

months from the time you submit the proposal to the time funds arrive—if all goes well. After receipt, the program manager sends your proposal to several (typically 4 to 6) outside reviewers for comments. A formal panel review may also take place, after which the program manager decides which of the panel's recommendations are consistent with program objectives, and how many such proposals the program budget can support. Once the proposal is approved, the final paperwork can take an additional 3 to 4 months.

The different parts of a proposal are described in their order of appearance: The **abstract** should include a brief statement of overall objectives and justification of the project; a brief statement of progress and accomplishments for a continuation proposal; a brief list of what will be done year by year, as well as how and why; and, at least for NASA proposals, a list of publications (2 to 4) you may have published on related topics.

A **summary of personnel** is not required, but it is useful to reviewers and program managers to have 1-paragraph descriptions of individuals who will be performing the work, stating what each individual will do in the study. In addition to the principal investigator, post-doctorate and graduate students may be unknown to most people outside their home institutions.

About 5 pages of single-spaced text should be devoted to the **project description**. You may include figures and tables to clarify your statements. This description is where you demonstrate how your project will contribute new knowledge to the geologic community and that you will be able to complete the work in the prescribed time.

You should provide enough information to show that 1) you have a well formulated scientific question to answer and that you have the technical experience to complete the work; 2) you are familiar with current literature, so that your study will build on previous investigations and will not overlook some critical aspect of the

problem; and 3) you understand the importance of your proposed research in furthering understanding of the geologic problem addressed in the proposal.

It also helps if you can show that you have thought of a new or different way of approaching the problem, and that this approach demonstrates not only your knowledge and ability in the field but also your unique expertise. Remember, the reviewers (and especially review panel members) will have many proposals to consider, so something new and different will stand out.

The **work plan** is exactly that: a plan of how you intend to complete the work, outlined in 1 to 3 pages. It is important to present a logical sequence of data collection, analysis, and interpretation. Try to estimate how long each part of the project will take to complete, and include a realistic schedule for finishing the investigation on time. A time-line chart that shows the order and degree of overlap of necessary work is extremely helpful.

Any field work, laboratory measurements, or computer analysis should be shown to be integral to the investigation, and enough time should be allowed for completion during the time period for which funding is sought. Clearly define any use of available data sets (maps, charts, etc.), and any field programs that you devise.

For **references**, make sure you've explored the literature in your proposal area. Authors of previous papers on the topic will undoubtedly be asked to review your proposal, and careless omissions of relevant work will cast doubt on your research abilities.

NSF requires a list of publications and major accomplishments on recent grants (for last 2 to 4 years) from the principal investigator submitting a proposal. This is to facilitate judging the potential for successful completion of proposed work. In the **bibliography**, for each of the key investigators you should include a summary of journal publications and relevant field and laboratory experience.

The budget should include the following items:

Salaries. Principal investigators supported by research grants invariably face the problem of covering their annual salaries. They often try to do this by submitting proposals that include full-time support when less than a full year's effort is required. As a result, project budgets are often inflated. At the other extreme, some investigators underestimate the

amount of time a project will take, and submit proposals that provide only a few weeks funding when in fact several months are required.

In both cases, a realistic number of months at a fixed salary is necessary. Usually new investigators may be funded for 3 to 6 months a year to work on a specific project, so 2 different grants (and, hence, different projects) may be needed to fully support that investigator. While this may appear to double the amount of work required, it can work to the investigator's benefit. Since start and end dates for 2 grants may be different, funding could continue irrespective of when any individual project might end.

Travel can be an expensive item in budgets, since it will include field work to do the research, and travel to conferences to present results. An amount equivalent to 5% to 8% of the budget is reasonable, but if special field work is required (in a foreign country with difficult logistics, for instance) then flexibility is called for also.

Equipment purchases must be program-specific and must be justified in terms of work proposed. However, it helps to show how the equipment will enhance future research by you or other researchers.

Computer time will depend on the type of research you intend to conduct, the method used to prepare reports and papers for publication, and the way your computer facility charges for use. In some cases, computers are free once the machine has been purchased, while other institutions charge overhead to maintain the machine and purchase replacement equipment every few years. Under normal circumstances about 2% to 5% of the total budget is allocated to computer charges.

Publication charges. Most journals charge for publication of an article at a set cost per page. Plan your publication requirements accordingly, and add some funds for document preparation (such as drafting and photography). Publication charges are usually less than 3% of the total budget.

Miscellaneous items include phone calls, photocopying, photography, sample preparation and analysis, maps and low-cost field gear. This category is typically 1% to 5% of the total budget.

Overhead. Be warned that all institutions impose an overhead charge on all money raised by proposals. This overhead charge covers such items as use of physical space (for example, cleaning your office, lights, secretarial support, security), as well as computer time and salaries of support personnel (such as grants officer,

technicians). Overhead rates range from 50% to 100% of the final budget. So if your project will cost \$50,000 to complete, a 50% institutional overhead charge means that you submit a proposal for \$75,000. Overhead is a particularly difficult item to deal with if you have a fixed-dollar proposal (for example, you have been told by the program manager that your proposal cannot be for more than \$40,000). If you are in this situation, it is often better to work backward from this fixed amount, take out the overhead, and then calculate what is left for real research.

What to do when funded. After getting funding, the single most important aspect of working on a project is to publish your results in the open literature (a journal that sends manuscripts out for peer review). Conference abstracts and talks are fine in themselves, but really do not count when it comes to judging your productivity. As a guide, most funding agencies use unofficial figures to judge productivity; something like 'one paper for every \$50,000 a year' or '3 papers a year for full-time support.'

There are other things you should do in addition to publishing your results. It is worth remembering that program managers are really on your side when it comes to promoting your type of research, once it is funded. Like individual scientists, program managers at NSF, NASA and ONR have to show that their program funds are being used well and that dynamic research is being done. You can help your funding agency and science program maintain or increase its share of annual funding in a number of ways:

- 1) Provide the program manager with reprints of recently published papers that they have supported.

- 2) Provide illustrative material (35-mm slides or 8x10-inch prints) of interesting new results even before they have been published. Current project descriptions let program managers show that they are running interesting and productive programs that should be funded next year.

- 3) Remember, once you are funded you will be part of the agency's science program. This entails support work for that program as well as publishing articles in journals. You may be asked to review proposals and serve on review panels, or to act as an advisor. These services help the program to provide the funds you need. So help by giving input and time!

While following this format does not guarantee success, presenting your ideas in a logical manner at a reasonable price will help tremendously. With any luck, writing a few

good proposals rather than taking a 'shotgun' approach should also give you more time to do what you are really interested in—geological research.

Peter J. Mougini-Mark

Planetary Geosciences Division, Hawaii Institute of Geophysics, University of Hawaii, Honolulu, 96822