

# “Building a Community of Women Geoscience Leaders”

a Proposal to the National Science Foundation for ADVANCE (PAID – rfp 05-584)

## I. Project Description

### A. Project Goals and Objectives

**Our vision** is to increase the retention of geoscience women in the academic pipeline and to create women geoscientist leaders by building a supportive geoscience community for women from a significant population center: the northeast U.S. This can serve as a model for other regions and other science, technology, engineering and mathematics fields.

**Our goal** is to build a community of women geoscience leaders through shared experiences to empower them with the skills needed to thrive in academia. We will transform department chairs and thereby significantly transform geoscience departments in a selected region so that all geoscientists feel welcome, supported, and productive.

**Our program objective is to build a Geoscience Community through:**

- 1) **Career Development Programs** to provide women with the skills they need to succeed in academia now. These include:
  - A) **1- day workshops on key skills** needed for academic success but rarely specifically addressed in doctoral programs, such as: strategic persuasion, having influence in your department and at your institution, and negotiation.
  - B) **5 -day writing retreats** for 1 or 2 weeks at a secluded location with professional writing guidance and shared feedback so that women leave with a paper or grant proposal ready for submission.
- 2) **Changing Department Climates** by providing geoscience department chairs with needed skills for assessment and improvement of their department’s climate through a series of three one-day workshops conducted by experienced facilitators.
- 3) **Keeping track of our success** through maintenance of a database of geoscientists in this region and across the nation and **publication of our results** on a website and in the literature.

**Our project is intended to broaden the impact of ADVANCE Institutional Transformation (IT) efforts** from those institutions that responded to a survey we conducted asking what they considered their “best practices” for increasing the numbers and retention of women in science, technology, mathematics and engineering (STEM) fields. Most of our respondents indicated that professional development workshops for women faculty and transformation of department chairs’ attitudes were effective means to these ends.

We intend to take these proven strategies and apply them to all geoscience departments in a selected region, the northeast U.S. There is a nearly complete sampling of types of institutions, from bachelor’s-granting through Research I institutions in this area, and we can reach women and department chairs at all of these. Notably lacking in the area are Historically Black and Under-represented institutions (HBCUs) that offer geoscience programs, but we hope to be able to expand our efforts to nearby New York (especially NYC where there is a large Hispanic population) and New Jersey (Elizabeth City State University is the only HBCU to offer a geology major) if our program proves successful.

## B. Expected Outcomes

We expect to increase recruitment and retention of women on geoscience faculty in this region within five years, as expected retirements will open up faculty positions. We will provide department chairs with strategies that they can see are workable and applicable (or at least adaptable) to their own departments. We will strengthen the bonds that already exist among these institutions by establishing the shared goal of gender equity of their faculty.

## C. Anticipated Project Impact

Our project can serve as a model for increasing gender equity in other STEM fields and in other regions of the country. While the Association for Women Geoscientists (AWG, of which we are both members and will partner with us in recruitment and dissemination efforts), supports a network of women geoscientists across North America, our focus on a small region will improve the sense of community there and facilitate networking among women academics, as women in this region are all within driving distance of each other and of our workshop and retreat venues.

## D. Innovativeness of Project

1) Academics identify strongly with their Institution and their Discipline. Previous ADVANCE IT awards have been used to increase the number of women professors at specific Institutions. Our unique approach focuses on a single discipline to instigate change, adapting many of the practices used at ADVANCE Institutions to one discipline, Geosciences (geology, meteorology, oceanography) in a specific geographic area.

2) In addition to demonstrated ADVANCE Activities, we offer writing retreats for women faculty and their collaborators (and, space permitting, post-doctoral fellows). Writing retreats are a long-established means of creating a supportive community of writers. They instill participants with increased confidence by witnessing the struggling of other writers; they offer daily peer review by fellow participants as well as experts; they suggest a variety of prompts to help writers overcome “writer's block”; and can offer communal workshop sessions in revision and editing strategies that benefit all who attend.

### **Complementary Proposal of Macdonald and Chan**

Macdonald and Chan are also submitting a proposal to the ADVANCE-PAID program to offer professional skills (COACH-like) workshops and other events for women at national geoscience meetings. We discussed our respective programs prior to submission and think that our proposed programs are complementary. Macdonald and Chan are targeting women geoscientists nationwide (primarily faculty), while we are targeting all of the women at all academic ranks in one area in order to build a community of women geoscientists. We believe that our approaches complement one another in that Macdonald and Chan’s approach is geographically broad, while ours is a deeper, more complete coverage in a specific region. We intend to build a network of women in close geographic proximity, whereas Macdonald and Chan will be able to offer these useful workshops to women from all parts of the country.

## E. Why these New Approaches are Needed

We have been working on gender equity issues (as funded by NSF) since 2001 (Holmes and O’Connell, 2005). We continue to hear complaints from department chairs that they lack strategies to increase hiring and retention of women on their faculty. The data affirm the lack of progress. Since we began tracking the numbers in 2001, the proportion of women on the faculty

of PhD-granting institutions in our target area, the northeast, has not changed at all (14% in 2001 and in 2005 using data from Claudy, 2002; Keane, 2004, and a search of each geoscience website in the region). Of 19 PhD-granting institutions, 7 have added female faculty, 11 have had no change in the number of female faculty, and one has lost 2 female faculty between 2001 and 2005. Bachelor's-granting programs have shown improvement, from 16 to 22% female faculty. But nowhere are hiring rates coming close to PhD-production rates (an average of 24% from 1991-2001, reaching 32% in 2001).

Of the 28 geoscience bachelor's degree programs, 22% (25) of the faculty are women (Table 1, "Total" column). Of these 25 women, only five are full professors. Eight departments, with two to five faculty members, have no women (Northeastern University (MA), Bridgewater State College (MA), University of Maine-Presque Isle, University of Southern Maine, Keene State College (NH), Roger Williams University (RI), Norwich University (VT), and Lyndon State College (VT).

Table 1. Numbers of women (left column) and men (right column) at geoscience degree-granting programs in New England. Number of programs (n) is given for each type of degree granted.

Program (n)	Assistant		Associate		Full		Total		Chair	
	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂
<b>PhD (20)</b>	14	52	17	72	20	192	51	316	35	15
<b>MS (6)</b>	1	10	5	2	0	5	6	17	0	2
<b>BA/S (28)</b>	13	20	7	28	5	40	25	88	45	13
<b>Total (54)</b>	<b>28</b>	<b>82</b>	<b>29</b>	<b>102</b>	<b>25</b>	<b>237</b>	<b>82</b>	<b>421</b>	<b>10</b>	<b>30</b>

There are six master's degree granting departments employing 23 faculty (Table 1). Six, 26%, of the faculty are women and two of the six departments (University of New Haven (CT) and Western Connecticut State University) have no women on their geoscience faculty.

Our first objective, developing a supportive network for women geoscientists (building a community), will decrease the sense of isolation for women in the 19 "lone-woman" departments in this region. Our second objective, workshops for chairs, will provide geoscience chairs with proven strategies to increase the numbers of women in their applicant pools and to assess their department's current climate. They will use results from that assessment to apply appropriate strategies to improve departmental climate and to increase retention of female faculty.

### Why the Northeast Population Center?

The northeast region contains fifty-four geoscience (earth science, marine science, environmental science, and meteorology) departments. The majority of these departments are within about a three hour drive from a central point.

To date ADVANCE-IT grants have been awarded principally to large public institutions. Within this small northeast region, we will have the opportunity to apply ADVANCE-IT practices to a variety of different types of schools, including small co-ed liberal arts colleges, all-women liberal arts colleges, small state schools, and large private and public universities. All of them need to increase the number of women on their geoscience faculty.

These northeast colleges have the advantage of a tradition of working together academically. Many subsets of schools have cooperative educational programs, e.g. the five-college program, the little three, the twelve-college exchange. But the geosciences have the strongest tradition of collaboration as a discipline, making the geosciences uniquely reachable. Beginning in 1901, New England geologists began meeting each fall for a field trip and

eventually called themselves the New England Intercollegiate Geological Conference (NEIGC; Caldwell and Weddle, 2005). Although a “nonorganization,” NEIGC is sustained because every year a different college (e.g. Yale University, 2005, University of Maine –Farmington, 2006) volunteers to coordinate and organize the field trips, make arrangements for accommodations and combine individual field trip guides into a published document.

These geoscience departments are willing to cooperate for this proposal. Letters and emails of support are included among “Collaborations”.

## **II. Building a Community of Women Geoscience Leaders: Methods**

### **A. Objective 1. Faculty Development**

We will offer specific skills workshops and writing retreats to assist geoscience women to reach their full potential and become leaders in the geosciences and at their institutions. An important part of this will be establishing a network for post-PhD geoscience women. Anecdotal evidence suggests that women scientists advance further if they network strategically early in their careers. NSF has just funded a \$1.2M, three-year study by Melkers and others (2006) to try to understand why.

#### **Objective 1a. Career Development Workshops**

The Committee on the Advancement of Women Chemists (COACH) was started in 1998 by a group of senior women chemistry faculty members to address the documented disparity in hiring and promotion of women in academic chemistry departments. One of the important products of COACH are a series of workshops that: 1) enhance professional and communication skills to aid women scientists in attaining professional goals, 2) provide networking with other women scientists, and 3) provide professional strategies to assist in enabling equal opportunities for all persons in their departments and institutions.

Although the impacts of COACH are currently being evaluated and have not been published, in a 2005 interview, when receiving the American Chemical Society's Award for Encouraging Women into Careers in the Chemical Sciences (Chemlin, 2005), Geri Richmond, the COACH chair, said that in post-workshop surveys:

- 1) 95% of the women chemists who have participated in the COACH workshops report that they have gone on to mentor other women in their departments, creating an avalanche effect.
- 2) 90% say they are experiencing less stress in their workplaces.
- 3) 82% have used their skills to negotiate for themselves, and
- 4) 65% have used these skills to negotiate for others.

We will adopt the three currently available COACH workshops as part of our faculty development effort (see letter of support from G. Richmond). They will be held at different schools to increase their accessibility and to promote ownership of the program by schools. All women with a geoscience-related PhD will be invited. Two workshops per year will be offered in sequence, enabling each workshop to be offered twice during the period of this grant.

These workshops include:

#### **Workshop #1: Coaching Strong Women in the Art of Strategic Persuasion**

*Facilitators: Lee Warren, Assoc. Director, Derek Bok Center for Teaching and Learning, Harvard Univ.; Nancy Houfek, Head of Voice and Speech, Institute for Advanced Theater Training, Harvard Univ.*

This workshop helps professional women be more effective when leading or participating

in discussions, meetings, or group negotiations. Participants learn about strategic rather than reactive behaviors and effective speaking voices, while tuning out stress and tension, to make themselves heard.

### **Workshop #2: Negotiation**

*Facilitators: Barbara Butterfield, Most recently Chief Human Resource Officer, University of Michigan; Jane Tucker, Senior Manager, Sap - Administration Systems Management Group, Duke University*

This workshop focuses on professional negotiation skills. Its multi-faceted approach includes some pragmatic learning content, case studies, and incorporates the real issues facing those attending the sessions.

### **Workshop #3: The Chemistry of Leadership: A Women's Leadership Program**

*Facilitator: Sandy Shullman, Executive Development Group - Columbus, OH*

This program is designed to give participants some basic concepts and tools to further develop their leadership skills. Participants learn about various concepts of leadership (including their own), explore what is known about gender and its role in leadership situations, reflect on their own leadership challenges, and do some self-assessment and planning to identify and develop areas for skill enhancement.

#### **Objective 1b. Writing Retreats**

We propose to offer two writing retreats for women geoscientists each year, to be held at the Weston Seismological Observatory and adjacent Campion Center (see letter from Dr. John Ebel, Weston Observatory Director). The retreats will last for up to one week in mid-winter and up to two weeks in summer.

Writing retreats have been used by professional and aspiring writers and musicians for decades. Of the many benefits ascribed to writing retreats, an increase in self-confidence and learning to write when you don't feel like it are two important features (T. Fulwiler, pers. comm.). Hundreds of writing retreats are offered these days (477 listed on one "resources" website alone). We could find no publicly available writing retreats directed towards scientists. Portland State University offers a writing retreat for faculty to write papers, grant proposals, and reports, and Dr. Toby Fulwiler of the University of Vermont offers a "Field Naturalist" program for students in Natural Science that comprises workshops and one to two writing retreats per year. Our proposed writing retreat will be unique and will fulfill a need in a way that is not currently available for women geoscientists.

The purpose of a retreat is to remove oneself from daily distractions and fully focus on writing. Such time and space are especially important for women scientists who are most likely to be working the double shift of maintaining a home as well as the full-time faculty job. Retreats are most effective when there is daily feedback on the work being produced. Ann Green, the director of Wesleyan University's Writing Center, has effective strategies to overcome writers block. The Wesleyan Center for Faculty Development will fund her to participate in our writing retreats. In addition, Dr. Toby Fulwiler of the U-VT Field Naturalist program has agreed to participate and review participants' writing. We also propose to invite members of our advisory board, local geoscientists serving as editors on geoscience journals, and Geoscience Directors from NSF to be on hand for ½ to 1-day periods to help provide insight and feedback on participants' writing.

Weston Observatory will provide office space for participants, web access, and a conference room for daily feedback. The adjacent Campion Center will provide low-cost rooms

with shared baths and all meals. The Campion Center is designed for retreats offered by resident Jesuit priests and provides a quiet, isolated setting away from distractions.

Participants will leave with a paper or proposal ready for submission to an appropriate journal or funding agency. This work will have been reviewed by peers and experts in the field.

## B. Objective 2. Department Climate: Department Chairs change for the better

In the northeast, the University of Connecticut recently terminated its Geology Department. This drastic action served as a vivid reminder to chairs all over the country, but particularly in New England, of the consequences of a department that fails to thrive. Our data indicate the loss of at least three graduate geology programs in New England in the last five years. Climate was an issue in some of these programs – a lack of a supportive environment – as well as a lack of productivity. The latter is an indication of faculty not performing at their full potential. There is clearly a need for department chairs to assess and improve their departments' climates.

Our chair workshops will be facilitated by members of the University of Rhode Island (URI) ADVANCE program as part of their ADVANCE-PAID proposal (see letter of support from Barbara Silver). These workshops have the overall goal of creating an excellent working environment where all faculty thrive in addition to promoting women in geosciences.

This will be done by implementing three models of change: the Transtheoretical Model, Appreciative Inquiry and a Three-Level Structural Change Model. Organizational change, especially in an academic environment, can be extremely difficult. URI has been able to identify and articulate the process of change and the unique factors that are salient in this particular milieu. This combination of workshops, using three approaches to change, has been successful in promoting change at URI (Silver, pers comm.).

### **Transtheoretical Model (TTM)**

The TTM (Prochaska and DiClemente, 1982) targets the process of *changing individual behavior* and is widely used in the medical profession, especially in smoking cessation programs. Now it is being successfully adapted to change organizational behavior. It identifies measurable patterns of change and identifies five stages that people or organizations move through as change occurs. At each stage, specific cognitive, affective, and behavioral strategies can be implemented to help the person or organization move to the next stage.

- 1) Precontemplation: change is not being considered. Here the objective is to help the organization begin to think about change through raising awareness and identifying how much better the department could be.
- 2) Contemplation: change is being considered.
- 3) Preparation: ready to make change though personal commitment and publicly committing to change.
- 4) Action: change is occurring; support is needed to reinforce positive behavior.
- 5) Maintenance: this requires the same behavior as action.

### **Appreciative Inquiry (AI)**

AI was developed in the 1980's to promote organizational change (Mohr and Watkins, 2002). Participants identify what is positive about their departments and discuss this with other members of the group. This leads to shared images of a positive department. Then, as a group, they determine what needs to be done to create that future, and develop an action plan and

follow-up steps. Here we can encourage chairs to develop a department in which all members thrive. The effectiveness of AI in this setting is that the interests of women faculty are infused within the larger context of creating an excellent working environment that everyone shares. Rather than marginalizing the specific needs of women faculty, participants put language to invisible departmental dynamics, assume ownership of those dynamics, and become invested in the change process (Silver, pers. comm.).

### **The Three-Level Structural Change Model**

The structural model identifies three levels on which actions occur: individual, interactional, and institutional. Chairs will be guided on how to enact change at each level, with an emphasis on the most intractable level, the interactional (between people). Institutional actions involve the formal policies and practices that are endorsed to promote the careers of women. Individual actions refer to the internalized beliefs and attitudes individuals endorse about supporting women. URI proposes, in accordance with Risman (2004), that even though individuals and institutions might work to create a healthy climate, climate change is difficult to realize when normalized and assumed interactions go unexamined. Appreciative Inquiry clarifies how these subtle interactions function in departments to create disadvantage for women and a chilly climate.

#### **Mechanics**

Department chairs will be asked to attend three workshops over a two year period, two the first year and one the second. The first two workshops will focus on departmental climate change. Between workshops, the URI facilitators will work with the chairs to help them implement change, and will provide follow-up contact and evaluation after the workshops end. As chairs may change every 2-3 years, both current and future chairs will be encouraged to attend. The final workshop will include broader components of an overall Organizational Change Model, including a Recruitment Package that URI is currently developing. Also in the last workshop, other administrators will be encouraged to join each chair in order to begin planning for climate change efforts at each school. We will contact Deans to ask them to encourage their geoscience chairs to participate. We had a very successful response to our first meeting (fall, 2005) for a few Boston-area chairs to discuss such a program, and the interest level was high (see letters of support from Tufts [graduate dean and department chair], URI [graduate dean], Weston Seismological Observatory [director], U-Mass/Amherst [department chair], Boston University [department chair and a female full professor], U-Vermont [department chair], MIT [department chair], and Dartmouth [department chair]).

The three-workshop sequence will be conducted twice, in different regions, e.g. the first set in the Boston/Amherst area and the second set for schools in Maine and New Hampshire. There are fewer schools in the second group, but those workshops will allow chairs who missed the first set, or new chairs, to participate. In addition, Maine is a particularly desirable target because of the low number of women faculty. At the University of Maine, the geosciences program has no women on their 18-man faculty, and their oceanography program has only one woman in a 16-person department (and there are more women with oceanography degrees than with other subdisciplines of the geosciences).

#### **Why partner with ADVANCE-URI?**

We have determined that this is a highly cost-effective way to promote change to an entire population center, the northeast U.S., and to see if a departmental climate change model successfully implemented at a single institution with a high level of institutional support (URI)

can be adapted by other departments to promote change. ADVANCE-URI has invested heavily in this promising approach, and adapting and disseminating this program to a wide audience will provide an economy of scale that will cover the entire New England region. URI facilitators have the social science expertise and experience needed to work with academics and are eager to work with us (see letter of support from Barbara Silver, their program director). In addition, using their established model will allow all of us to identify successful practices that can be adapted to different types of institutions, as well as unsuccessful practices that can be discarded.

Finally, URI is also known in the geoscience community as having an outstanding Graduate School of Oceanography. In addition to assessing the change in each geoscience department, we will also be able to see the impact of change at URI where the Geology Department and the Marine Geology & Geophysics Division at the Graduate School of Oceanography will participate in both the institutional and discipline workshops. This will be a good indicator of how much assistance some departments will need to develop a favorable climate for women.

### C. Objective 3. Maintain a Database and Publicize Our Program with a Website

We rely upon a database of all academic geoscientists from the American Geological Institute (the *AGI Directory of Geoscience Departments*). This database is compiled by AGI from departments' self-reporting: filling out forms supplied by AGI. One obvious issue with such a database is that many departments will let years pass before updating their information to AGI. When we examine specific cohorts of individuals (such as, "all Assistant Professors who received a PhD between 1990 and 1994", so that we can determine tenure rates), we must look up every individual for current rank on departmental and personal websites and/or contact departments directly.

We continue to put a great deal of time into looking up missing or obviously dated information (for example, hundreds of entries may have no graduation year, or no school from which the PhD was obtained, or are listed as "Assistant" when the date of hire indicates promotion should have occurred already). Ideally, we would survey all departments and get 100% compliance, but until that day arrives, we will continue to rely upon and update the AGI database. It is a time-consuming (but we believe worthwhile) process even before we begin analyses that leads to results such as we illustrate in Tables 2 and 3 in section IV.

### D. Management Structure

The "Building a Community of Women Geoscience Leaders" program will be managed by a committee consisting of three program directors and six members from the consortium. Suzanne O'Connell and Mary Anne Holmes will be the co-directors. Marilyn Bibeau (Weston Observatory) will be an assistant director. The six- consortium members will include a minimum of two department chairs and two women geoscience faculty. Committee members must agree to serve a two-year term and will be asked to serve by the program managers for the first term. Subsequent appointments will be by committee selection. They will be selected to provide diversity in the type of school and in geographic location. A minimum of two meetings will be held each year, one on site in conjunction with a workshop or a retreat and one via teleconference. Meeting notes will be distributed to all members of the consortium within a month of the meeting. An annual report will be sent to all members of the consortium in January.

## E. Dissemination of Results

We will continue to disseminate results of our work at national geoscience meetings (Geological Society of America, American Geophysical Union). These organizations have hosted theme sessions on the diversity issue (i.e., the lack of diversity) in the geosciences for the last four years and we have been invited to help organize or present at several of these (see Section IV; D. Publications; Abstracts). We have and will continue to publish in the non-technical, widely-circulated geosciences magazines, *Eos* (AGU) and *Geotimes* (American Geological Institute). We will publish in the Association for Women Geoscientists (AWG) newsletter and the Association for Women in Science (AWIS) journal and other scientific journals that may be interested in the gender equity issue. In addition, we will create a website (experienced webmaster at Wesleyan) for recruitment and for methods and data dissemination.

## III. Evaluation and Benchmarks

### A. Evaluation

Formal evaluation will be done by Deborah Matthews (see her cv in Supplemental Documents). She is the primary evaluator for the URI-ADVANCE program and is familiar with the goals of ADVANCE. Through URI-ADVANCE-PAID funding, she will evaluate all of the workshops, making evaluation highly cost effective. In addition, this is a further dissemination of practices from ADVANCE IT institutions.

The evaluation process will begin as the programs are being organized. Matthews will help us to identify positive and negative practices in each workshop (COACH and chair), and changes will be implemented in subsequent workshops.

We expect changes to be made in the writing retreats as we identify successful and unsuccessful practices, e.g. is a two-hour writing warm-up by a professional writing instructor important? is five days long enough? What is the best method to eliminate outside distractions (email, phone calls) while at the retreat? How formal a daily/weekly structure is needed?

Matthews' assessment will consist of the following activities:

- Review the design of the project and maintain a database to assure that data are collected in a manner that will provide information usable in the evaluation design.
- Structure and conduct interviews/focus groups of participants (and non-participants) to collect information about their perceptions of project operations, outcomes and potential improvements.
- Develop and use appropriate instrumentation (periodic meetings, focus groups, informal conversations, memos, reports, and verbal presentations) to collect information on project implementation and outcomes.
- Complete and present interim and final evaluation reports.

### B. Benchmarks

#### 1. Hiring and retention.

One important benchmark of success will be the addition of more than one female geoscientist on the faculty of those PhD-granting institutions that currently have none. Another is the elimination of "lone woman" departments by seeing at least one additional female faculty member hired by these departments wherever possible. In addition, we expect to see increased

retention of female scientists by a statistically significant increase in the numbers of women holding “Associate” and “Full” Professor positions.

## 2. Papers and proposals.

We will ask writing retreat participants to acknowledge NSF funding for the workshop in their papers and submit an electronic copy of abstracts of funded proposals and accepted/published papers for inclusion on our website.

## IV. The Current Status of Women in the Geosciences:

### Results of Prior Support from ADVANCE:

NSF Awards #0123669 (10/01/01 to 10/01/04) and #0410255 (supplement; 5/12/04 to 10/01/05)

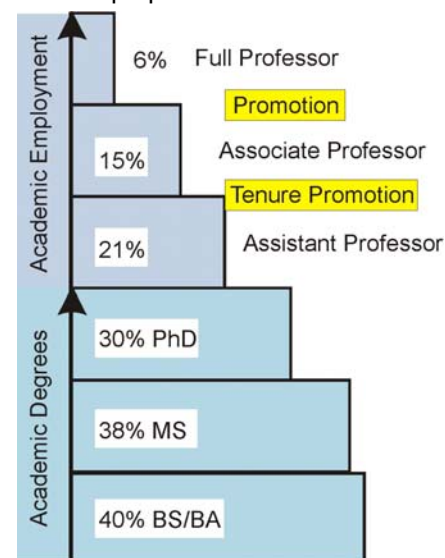
The goals for our first ADVANCE grant were: 1) to collect data on the status of academic women in the geosciences, 2) to conduct focus groups of geoscientists to determine their perceptions of the status of women in the geosciences, and 3) to conduct a workshop to share and disseminate data and strategies to progress towards gender equity for geoscientists in academia.

Data collection was accomplished through analyses of electronic versions of four editions (publication years 1996-97 [compiled by Ongley et al., 1998], 2001-02, 2002-03, 2004-05) of the American Geological Institute’s *Directory of Geoscience Departments*. We published the following information in the list of references that follows.

### A. The Status of Women in the Geosciences

- 1) The **largest exodus in the academic pipeline for women is between the PhD and the academic position**, followed by under-recruitment of women into our field as a major in college (Fig. 1). We learned that **women exit from the pipeline at every stage of the career**, even after “winning the brass ring” of tenure.
- 2) The percentage of women in Assistant Professor (entry-level) positions did not change between

**Figure 1. A snapshot of the status of women in the geosciences, 2001-02:** The proportion of women in the geosciences decreases with each step up the academic ladder.



Data for academic degrees: NSB; for academic employment: American Geological Institute. Employment data are for all degree-granting institutions in the AGI *Directory*. Figure modified from DeWet and Ashlev, 2004.

**Table 2.** The proportion of women at various ranks at PhD-granting institutions.

Year	2004-05	2001-02	2000-01	1996-97
Assistant Professor	26%	23%	21%	20%
Associate Professor	14%	14%	15%	14%
Full Professor	8%	8%	9%	5%
Chair, Head	10%	8%	7%	4%
<b>Total</b>	<b>13%</b>	<b>12%</b>	<b>12%</b>	<b>9%</b>

1996-97 and 2001-02, and is around 20% for all degree-granting institutions (Table 2).

- 3) The proportion of women declines as the degree granted by the institution

advances (Table 3). Seventeen percent of the faculty at bachelor’s degree-granting institutions are women; only 13% at PhD-granting institutions are women (2004-05).

- 4) There is a high proportion of women in non-tenure-track positions at all types of institutions, including museums and research institutes.
- 5) There is no significant difference in tenure rates between men and women. Tenure rates are about 75% for either gender.
- 6) There appears to be a gross over-production of PhDs in the Geosciences, as only about 7% of people who received a PhD in the last 10 years are now listed at a geosciences institution in the *Directory*.
- 7) 47% of people listed in the *Directory* who are employed at PhD-granting institutions and received their PhD in the last 10 years graduated from one of 20 schools. 57% come from 35 schools.

**Table 3.** The proportion of women on the geosciences faculty declines as the rank of degree granted increases.

Year	04-05	01-02	00-01	96-97
Bachelor's-granting	18%	17%*	16%	12%*
Master's-granting	17%	14%	14%	12%
Doctoral-granting	13%	12%*	12%	9%*

\*significantly different, chi-squared test

We conclude from the data that **the continued exodus throughout women’s careers indicates that “the pipeline” will not “fix” the problem.** We must reduce the exits – increase retention - to increase the proportion of women in academia.

## B. What We Learned from Focus Groups of Geoscientists

During the first half of 2003, we conducted focus groups of geoscientists by teleconference in separate male/female groups, separated by academic rank. We recruited 91 participants from all types of academic institutions, from across the country, and were able to recruit persons from under-represented racial and ethnic groups into more than half of the focus groups.

- 1) **The single largest influence in what attracts people into the geosciences is stumbling into an undergraduate class and becoming inspired by the material or a professor:** nearly 40% of geoscientists in our focus groups cited a freshman class as their principal attractor (Table 4).
- 2) About equal proportions of males and females perceive that the data on the status of women in the geosciences indicates “not much change” or “no change” in women’s status over the last 5 years. In contrast, about 1/3 of both males and females were pleasantly surprised that the proportions of women “had improved so much”.

**Table 4.** Factors that attracted our focus group participants to become geoscientists.

Response	Women	Men
Undergraduate Experience	38%	33%
Love of Outdoors, Subject Matter	22%	28%
Family: individuals, vacations	20%	20%
Other	13%	13%
K-12 teacher, experience	7%	6%

- 3) Whether they thought the status of women has improved or not, males in the focus groups had many more opinions about why the numbers appear low (Table 5). The principal explanation is that “we need more time” for the pipeline to supply women; secondly, that there is

a lack of female mentors for female students; thirdly, that “women choose

**Table 5.** What Geoscientists Think About Why Numbers of Females are So Low. Numbers in parentheses are the numbers of focus group responses; one person may have had more than one response.

Males	Females
• Need more time – “the pipeline” (16)	• Family issues (9)
• Lack of female mentors (10)	• Climate issues (5)
• Women are choosing a non-academic career (4)	• Need more time – “the pipeline” (5)
• “Societal expectations” (4)	• Lack of female mentors (3)

a nonacademic career” (they don’t want to work in academia), and finally, that women have “societal pressures” to get married and start families, which they felt was incompatible with an academic career.

- 4) Women had fewer explanations for low numbers (Table 4), but these included: 1) family issues (including trailing spouse issues and caring for aging relatives, as well as starting their own families), 2) climate issues within departments (hostile atmosphere), and 3) agreeing with males, that “we need more time” and “there is a lack of female mentors”.
- 5) Nearly ½ of women in the focus groups had seriously considered leaving the geosciences once they had entered, while only 1/3 of males had. Women’s reasons for considering leaving included mostly family issues and difficulties with their graduate advisor. Men’s reasons were largely focused on uncertain job markets.
- 6) Currently, male and female students perceive family life as incompatible with the life of an academic scientist. In the words of one female student, “...if you’re a research scientist than you probably can’t and won’t have kids.”

### C. Workshop and Workshop Report

In September 2003, we conducted a workshop with 50 participants from across the country. The participants represented all types of academic institutions and all ranks (except undergraduate students) in the academic community. We compiled our data and discussed strategies to improve the status of women over a two-day period. Our results were published in January, 2005, in a Workshop Report, “Where are the Women Geoscience Professors?”.

We mailed the report to every geoscience department head in the country, to every workshop participant, and to every AWG board and committee member. We distributed them at every regional and national geoscience meeting held between 1- 2005 and 12-2006 and to over 100 people in the oil industry. The response to the report was overwhelming. Within six weeks, requests for extra copies depleted the initial printing of 3,000 copies, and we had another 2,000 copies printed. In addition, 140 .pdf copies have been downloaded from the AWG website. Considering that only 14,000 names are listed in the *AGI Directory of Geoscience Departments*, we feel that the workshop report filled a pressing need for information on this topic.

## D. Publications to date

- O'Connell, S. and Holmes, M.A., 2005, Women of the Academy and the Sea; *Oceanography*, 18(1): 12-24.
- Holmes, M.A., and O'Connell, S., 2005. Where are the women geoscience professors? Report on the workshop held in Washington, DC, Sept. 25-27, 2003. Published by the authors and available online at <http://www.awg.org/gender-workshop03/download.html>.
- Foos, A., Holmes, M. A., and O'Connell, S., 2004. What does it take to get tenure? *Geotimes*, vol. 49, no. 5, pp. 38-39.
- O'Connell, S., and Holmes, M.A., 2004. Where are the women geoscience professors? *AWIS Magazine*, 33(1):11-16. Association for Women in Science.
- Holmes, M.A., and O'Connell, S., 2004, Reply to Comment on "Academic specialties in U.S. are shifting: Hiring of women geoscientists is stagnating". *EOS, Transactions American Geophysical Union*, 85(6):58.
- Holmes, M.A., and O'Connell, S., 2003, "Where are the Women Geoscience Professors?" Workshop. *EOS, Transactions American Geophysical Union*, 84(50):564.
- Holmes, M.A., O'Connell, S., Frey, C., and Ongley, L., 2003. Academic Specialties Shifting; Hiring of Women Geoscientists Stagnating. *EOS, Trans. AGU*, 84(43):457, 460-461.
- Holmes, M.A., O'Connell, S., Frey, C., and Ongley, L., 2003. The Status of Women in the Geosciences, 2001. *Geotimes*, vol. 48(9):24-25.

### Abstracts

- O'Connell, S. and Holmes, M.A., 2005. Best Practices for Hiring and Retaining Women Geoscience Faculty. **Invited**. *Geological Society of America (abstracts)*, Salt Lake City, October, 2005, Vol. 37, No. 7, p. 260.
- Holmes, M.A., O'Connell, S., and Frey, C., 2004, Hiring and Retention: Key Factors in Increasing Gender Diversity in the Geosciences, **Invited**, *Eos Trans. AGU*, 85(47), Fall Meet. Suppl., Abstract ED23B-0099.
- Holmes, M.A., O'Connell, S., and Frey, C., 2004. The Status of Women in Geoscience Academia: data and perceptions. Holmes, Suzanne O'Connell, Connie Frey. GSA Abstracts with Programs Vol. 36, No. 5.
- Frey, C., & Horvick, J. (2003, May 20). Comparison of traditional and telephone focus groups. A paper presented as part of a session entitled "Focus Groups" at the International Field Directors and Technologies annual conference in Nashville, TN.
- Holmes, M.A., O'Connell, S., and Frey, C., 2003. What Makes a Geoscience Major? What Makes a Geoscientist? Results from Focus Groups of Geoscientists, 2003. *Geological Society of America (abstracts)*, Seattle, November 2003, v. 35,
- Holmes, M.A., O'Connell, S., Frey, C., and Ongley, L., 2002. Gender Diversity in the Geosciences: Current Status and Future Trends. *Trans. AGU*, San Francisco, December 2002, p. 199, Fall Meeting Program.
- Holmes, M.A., O'Connell, S., Frey, C., and Ongley, L., 2002. Geoscience Gender Diversity in the Academy: We are Still Waiting. *Geological Society of America (abstracts)*, Denver, October 2002, v. 34, no. 6, 205-12, p. 469.
- O'Connell, S., Frey, C., and Holmes, M.A., 2003. Focus groups reveal differences in career experiences between male and female geoscientists. *invited; Eos Trans. AGU*, 84(46), Fall Meet. Suppl., Abstract ED22D-1255.

## V. Project Timeline

We will begin to hold the Career Development (COACH) workshops in January, 2007 and develop evaluation procedures that will be consistent throughout the program with that workshop. “GSA/AGU” in the table below refers to our presentation of results at national meetings of the Geological Society of America (GSA) and the American Geophysical Union (AGU). GSA is a venue for more traditional geology while AGU encompasses atmospheric and oceanic as well as Earth sciences. The audiences are different.

		<b>Career Development Workshop</b>	<b>Writing Retreat</b>	<b>Chair Workshop</b>	<b>Data base</b>	<b>Evaluation</b>	
2006	Fall- Winter	organize presenters, publicize	publicize	publicize	↓	evaluation procedures	
2007	Winter	Workshop#1A	5-day retreat			↓	↓
	Spring			<i>Workshop #I-1</i>			
	Summer		2 wk retreat	<i>Workshop #I-2</i>			
	Fall	Workshop #2A					
2008	Winter	Workshop #3A	5-day retreat			↓	↓
	Spring			<i>Workshop #I-3</i>			
	Summer		2 wk-retreat	Workshop #II-1			
	Fall	<i>Workshop #1A</i>		Workshop #II-2			
2009	Winter	<i>Workshop #2B</i>	5-day retreat			↓	↓
	Spring			Workshop #II-3			
	Summer		2-wk retreat				
	Fall	<i>Workshop #3B</i>			GSA / AGU		

## VI. Broader Impacts

With our first grant from ADVANCE, we raised awareness in the geosciences community about the lack of women in academic (and nonacademic) positions. The response to

our workshop report from our previous grant indicates a high interest level for workable strategies to move us toward gender equity.

In September, 2005, we invited department chairs within a 150-mile radius of Boston to meet with us to discuss strategies to increase the recruitment and retention of women in the geosciences in that region in September, 2005. Eleven people representing nine institutions (Boston College, Weston Observatory, MIT, Yale, Harvard, Tufts, Wesleyan, the Woods Hole Oceanographic Institution and from a bit farther afield, the University of Nebraska-Lincoln, funded by that department) took the time to come. The interest level was very high among these leaders in the geosciences, whose departments lack the diversity they feel is needed. Many of these participants have written letters of support for this proposal.

This project can disseminate strategies that will change the professoriate and the climates in geoscience departments throughout the region, including five of the top twenty Research I institutions in our field (MIT, Woods Hole, Brown, Yale and Harvard). A positive climate for geoscientists will enhance the academic experience for students as well as for the faculty. When this viable, productive network of women geoscientists is established, our model can be applied to other key population centers and indeed, to other STEM fields. Why not regional networks for women physicists, women engineers, women chemists? Why not regional networks in the DC-area, around Atlanta, the Puget Sound, Chicago, southern California, or elsewhere? This model could easily spread to other areas.

## **VII. Intellectual Merit**

We will apply strategies that other ADVANCE-IT institutions have stated are “most effective”: career development workshops for women geoscientists, and workshops for chairs to assess and positively change their department’s climate. In addition, we will offer the unique opportunity of writing retreats for women, and these, together with the career development workshops, will help us to establish a network of women geoscientists in academia. This network will provide the needed support for the many women isolated as the lone woman in their departments. It will provide these women with access to mentors, editors, and needed guidance to move towards positions of leadership in the geosciences. Our selected geographic region holds already-established leaders in the geosciences (5 of the top twenty research I institutions). Now we will put a female face on them.