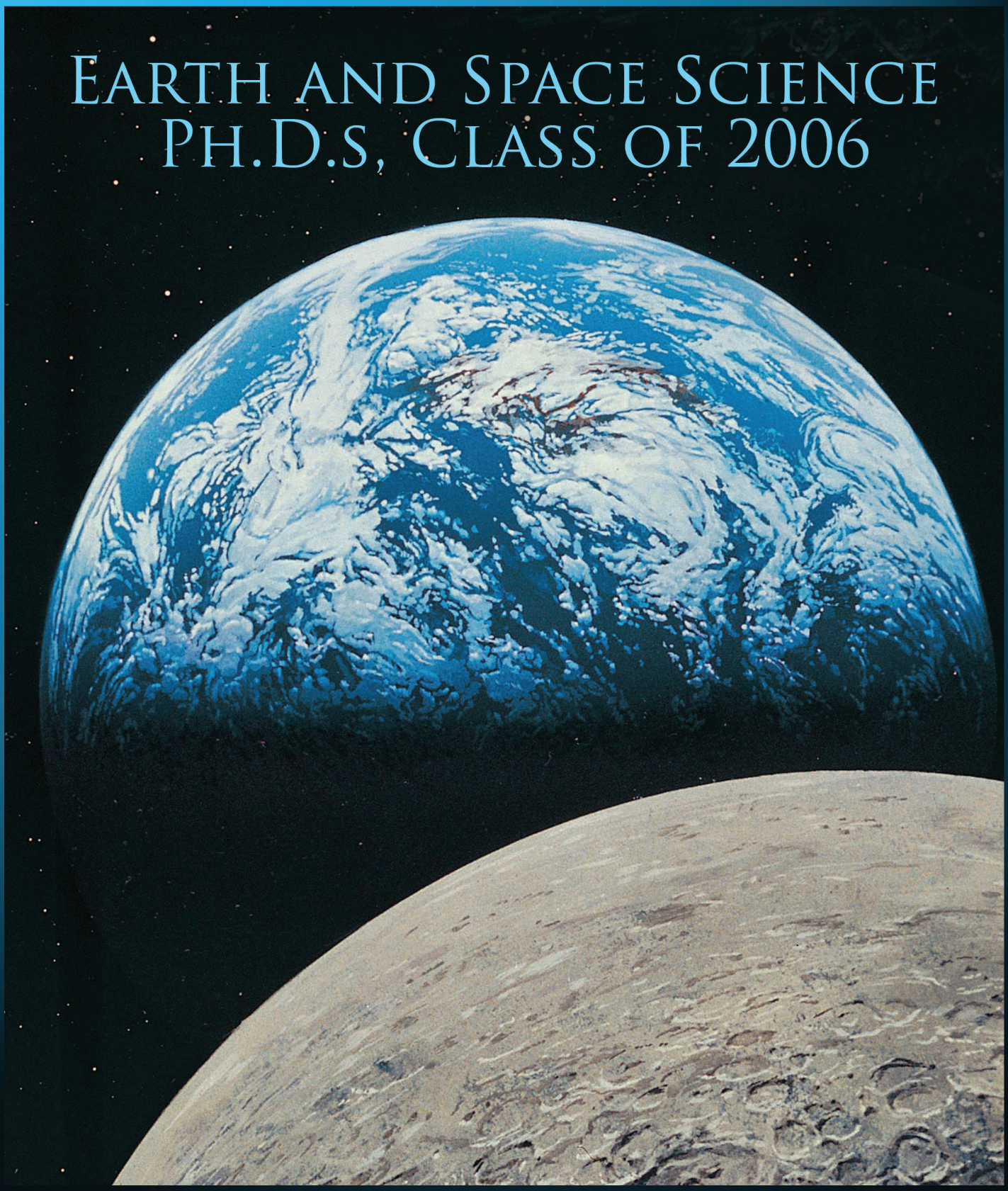
Earth and Space Science Ph.D.s, Class of 2006



Garrett Anderson
Cindy Martinez
Roman Czujko
Paul Cooper

February 2009

AGU

SERVING THE GEOSCIENCES WORLDWIDE
AGI
THE AMERICAN GEOLOGICAL INSTITUTE

HIGHLIGHTS

- The percentage of those new graduates who find initial employment as post-docs has leveled off, with approximately 56 percent of new Ph.D. recipients working as post-docs in both academic and government research institutions.
- Recent geoscience Ph.D. recipients accepting postdoctoral positions report that their work is challenging and directly related to their specific research interests. However, postdocs earn low salaries, averaging $43,100 in academe and $55,200 in government.
- Only about 11% of new geocience Ph.D. recipients work in the private sector. Nearly 70% of those working in the private sector report that their first jobs are related to the geo sciences. Ph.D.s working in the private sector earn the highest salaries of all new graduates, averaging $72,500.
- The proportion of women earning Ph.D.s in the geosciences has increased from 19.1% in 1990 to 34.1% in 2005. Within the limits of the comparatively small number of respondents, women geoscientists appear to earn at least the same salaries as their male colleagues.
- The Ph.D.s of 2006 rated the geoscience job market more positively than did any other new geosciences class over the last decade.

INTRODUCTION:

This report describes the initial employment during the spring of 2007 of geoscientists who earned their Ph.D.s during the preceding academic year. The term geoscience is used throughout the report and refers to a broad range of fields in Earth, atmospheric, ocean, and space sciences (see Appendix for list of fine fields). The report is based on a survey of geosciences Ph.D.s whose degrees were awarded between April 2005 and December 2006 and who remained in the U.S. after earning their doctorates. The Appendix provides a detailed description of how the survey was conducted.

AGI and AGU have collected data on recent Ph.D.s in the geosciences from the classes of 1996 through the present. In 1996 and 1997, the survey was conducted as part of a multidisciplinary effort coordinated by the Commission on Professionals in Science and Technology (CPST) and supported by the Alfred P. Sloan Foundation and the National Science Foundation (NSF). Since 1998, AGI and AGU have continued this effort and evolved the survey to provide a more complete picture of geoscience graduates. Data collection and analyses are performed by the Statistical Research Center (SRC) of the American Institute of Physics.

NEW GEOSCIENCE PH.D.S

New Ph.D. recipients in the geosciences are entering a strong job market, and are finding employment in a variety of settings across the economy. Few new graduates are unemployed within a year of receiving their degrees (Table 1). Approximately 57 percent of new graduates are working in post-doctoral positions.

Table 1. Current Status of Recent Geoscience Ph.D. Recipients, Class of 2006

Employment Status		Number
Working		152
Postdoctoral position	86	
not Postdoc	66	
Not working, seeking employment		5
Not working, not seeking employment		5
Total Respondents		**162**

THE MOST REWARDING ASPECT OF MY JOB IS:

Being able to successfully apply the research tools (analytical techniques & experimental approaches) learned during my Ph.D. to new scientific problems."

- Geoscience Ph.D. recipient, Class of 2006

Two-thirds of all Ph.D. graduates work in academe, 20 percent work in government, and 11 percent in private industry.

Table 2. Employment Sector of Geoscience Ph.D. Recipients, Class of 2006

	Number	%
Academe		**67**
4-year College or University	76	
University Affiliated Research Institute	22	
Other Academic Institution	4	
Government		**19**
Regulatory Government	3	
Government Research	22	
Government Forecasting	1	
Other Government	2	
Private Sector		**11**
Industry - Oil and Gas	5	
Industry- Environmental	3	
Industry- High Tech	1	
Other Industry	7	
Self Employed	1	
Non Profit & Other		**3**
Non-profit Research Institute	5	
Total Number	**152**	

THE MOST REWARDING ASPECT OF MY JOB IS:

"Doing work that I enjoy. Having a job that I look forward to every morning."

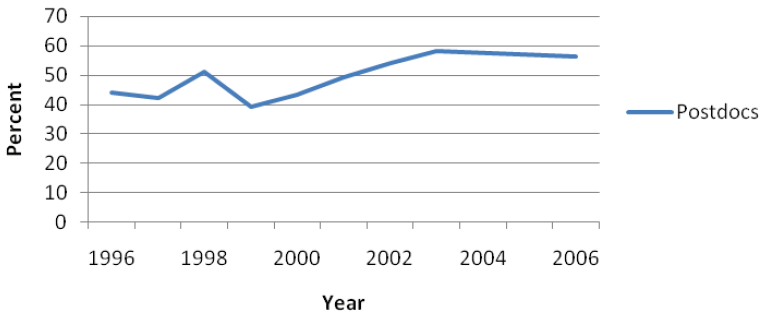
"The chance to do independent research and to chart my own research path."

"Doing very interesting science with a top-notch group of fun people."

-Comments from Geoscience Postdocs in Academe, Class of 2006

The number of new Ph.D.s accepting postdoctoral positions has been flat around 56% for the last 3 years after increasing substantially from 1999 through 2003 (Figure 1). Looking at individual employment sectors, 64 percent of new geoscience Ph.D.s working in academe and 61 percent working in government are post-docs, with a small numbers working as post-docs for non-profit organizations. Only 35% of all new Ph.D. recipients reported that they had a permanent or potentially permanent position at the time of the survey (Table 3).

Figure 1. Percent of new geoscience Ph.D.s working in postdoctoral positions, 1996-2006



Source: AGU & AGI Survey of New Geoscience Ph.D.s
Data for 2004 & 2005 are unavailable

Table 3. Type of Employment by Sector for Geoscience Ph.D.s, Class of 2006

	Academe %	Gov't %	Private Sector %	All %
Post-doctoral app't.	64	61	0	56
Other Temporary	12	0	6	9
Permanent or Potentially permanent	24	39	94	35
Total Number	102	28	17	152

Table 4. Employment Sector for New Geoscience Ph.D.s, 1996 to 2006									
	1996	1997	1998	1999	2000	2001	2002	2003	2006
Postdocs	%	%	%	%	%	%	%	%	%
Academe	36	31	32	25	23	33	35	39	43
Gov't	5	6	11	12	15	13	14	14	11
Industry	1	1	0	1	1	1	1	0	0
Non-profit	2	4	8	1	4	2	4	5	3
Non-Postdocs									
Academe	30	27	20	27	23	24	28	25	24
Gov't	13	10	8	17	14	11	8	5	7
Industry	11	19	20	16	19	15	9	10	11
Non-profit	2	2	1	1	1	1	1	2	1
Total Number	**123**	**327**	**144**	**157**	**150**	**211**	**204**	**145**	**152**

Footnote: 2004 & 2005 data are unavailable.

Geoscience Ph.D.s get jobs in the science and engineering workforce. Eighty-six percent of new Ph.D.s work in jobs related to the geosciences and nearly all new Ph.D.s (98 percent) work in a science-related job (Table 5).

Table 5. Field of Employment for New Geoscience Ph.D.s, Class of 2006					
	Employment Sector				
	Any Postdoc	Pot. Perm Academe	Private Sector	All other	Total
	%	%	%	%	%
Geoscience	**99**	**70**	**69**	**76**	**86**
Other Science	**1**	**26**	**25**	**20**	**12**
Non-Science	**0**	**4**	**6**	**4**	**2**
Total Number	**79**	**27**	**16**	**25**	**147**

Footnote: All other includes government non-postdocs, temporary academe, and non-profit.

Typical salaries for new geoscience Ph.D.s vary across employment sectors. Average salaries for all sectors are slightly higher than in years past, likely due to inflation and to compensate for recent increases in the cost of living. The private sector pays the highest salaries. Postdocs in academe have the lowest average salaries of new geosciences Ph.D.s.

Table 6. Starting Salaries for Geoscience Ph.D.s, Class of 2006				
	Average Salary $	Median Salary $	Typical Salary $	Ph.D. N
Postdoc - Academe	**43,100**	**42,000**	**37,300 to 48,500**	**61**
Potentially Perm - Academe	**51,900**	**52,500**	**45,000 to 60,000**	**23**
Postdoc - Government	**55,200**	**53,000**	*	**16**
Private Sector	**72,500**	**71,000**	*	**15**

Footnote: These data are based on full-time employed Ph.D.s. They do not include individuals who worked full-time for 12 or more months prior to earning their degree.

Typical Salary Range is the middle half of all reported salaries, i.e. one-quarters of the salaries are less than and one-quarter are more than the typical salary range.

*There were too few respondents to report reliable salary range.

THE MOST REWARDING ASPECT OF MY JOB IS:

"Working in an environment with sufficient facilities to do serious research."

"Being able to collaborate and discuss research with colleagues."

-Comments from Geoscience Postdocs in Government, Class of 2006

PERCEPTIONS OF INITIAL EMPLOYMENT

New geoscience Ph.D.s acquire useful knowledge and skills through their academic experience. Postdocs and other Ph.D.s working in academe were most likely to report using broad knowledge of the geosciences and specific knowledge of their research field in their work. Ph.D.s that go into the private sector are the least likely to use knowledge of their research field (Table 7).

Table 7. Knowledge and Skills used by New Geoscience Ph.D.s in their Current Job, Class of 2006

	Percent Reporting Often or Extensively					
	Cognitive Skills	Technical Skill	Research Field	Broad Knowledge of Geoscience	Mgmt Skills	New Ph.D.
	%	%	%	%	%	N
Any Postdoc	96	94	97	90	70	77
Potentially Perm. Academe	89	75	79	79	82	28
Private Sector	94	75	44	75	75	16
All Other	80	81	77	65	81	26
Overall	92	86	85	82	75	147

Footnote: All other includes government non-postdocs, temporary academe, and non-profit.

Respondents were asked to indicate their opinions on a 5-point scale from "extensively" to "not at all". This table represents the percent of respondents who selected the two most positive responses.

A majority of Ph.D.s work in jobs that they report are related to their degree field, appropriate for their level of education, and are professionally challenging. Ph.D.s in postdoctoral positions were most likely to report these characteristics of their job. Only 65% of respondents working in "all other" positions reported that their jobs were appropriate for a Ph.D.. Likewise, only half of Ph.D.s working in "all other" reported that their jobs were challenging.

Table 8. How New Geoscience Ph.D.s Rated their Current Job, Class of 2006

	Percent with Positive Rating			
	Related to Degree Field	Appropriate for Ph.D.s	Professionally Challenging	New Ph.D.
	%	%	%	N
Any Postdoc	92	96	86	78
Potentially Perm. Academe	82	86	86	28
Private Sector	63	88	81	16
All Other	73	65	50	26
Overall	84	88	79	148

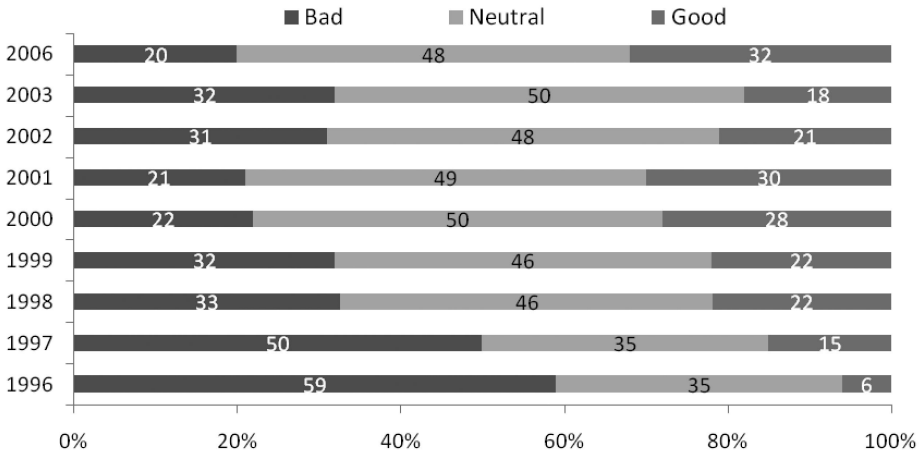
Footnote: All other includes government non-postdocs, temporary academe, and non-profit.

Respondents were asked to indicate their opinions on a 5-point scale. This table represents the percent of respondents who selected the two most positive responses.

JOB MARKET RATINGS

How new geoscience Ph.D.s rate the job market depends on their personal experience and their impression of the state of the field as a whole. Ratings improved from the mid 1990s through 2001, declined in the early 2000s, and recovered to a current high of 32% reporting a good state of the job market. The new geoscience Ph.D.s of 2006 rated the job market more positively than did any other Ph.D. class over the last decade. In the past decade, about half of Ph.D.s reported a job market rating of neutral (Figure 2).

Figure 2. New Geoscience Ph.D. Job Market Ratings, Classes of 1996-2006



Source: AGU & AGI Survey of New Geoscience Ph.D.s. Bad includes responses of bad or hopeless. Good includes responses of good or excellent. Data for 2004 & 2005 are unavailable.

Salary is a predictor of job market ratings (Table 9). Even within the relatively narrow range of salaries for all new geosciences Ph.D.s, those who gave higher job market ratings were earning higher average salaries.

Table 9. Salaries by Job Market Ratings for New Geoscience Ph.D.s, Class of 2006

Job Market Rating	Average $	Typical Range $	Ph.D. N
Bad	47800	38000 - 56000	23
Fair	50400	40000 - 54000	59
Good	54600	42800 - 62500	34
Excellent	58700	*	6

Footnote: These data are based on full-time employed Ph.D.s. They do not include individuals who worked full-time for 12 or more months prior to earning their degree.

Typical Salary Range is the middle half of all reported salaries, i.e. one-quarter of the salaries are less than and one-quarter are more than the typical salary range.

*There were too few respondents to report a reliable salary range.

THE MOST REWARDING ASPECT OF MY JOB IS:

"Fantastic owners and bosses, exposure to all aspects of the industry, flexible schedule, and an excellent and fast-paced work environment."

"Being part of a team that generates creative solutions to challenging environmental problems. Actually doing remediation, in addition to site characterization."

-Comments from Geoscientists in the Private Sector, Class of 2006

Though Ph.D.s in postdoctoral positions rate their jobs positively in terms of being related to their degree, challenging, and appropriate for their education level, they have the poorest job market ratings (Table 10). This may be, in part, due to the temporary nature of their current employment and concern about their career opportunities after they complete their postdoctoral appointments.

Table 10. Job Market Ratings by Employment Sector for New Geoscience Ph.D.s, Class of 2006

	Bad %	Neutral %	Good %	Ph.D. N
Any Postdoc	28	45	27	76
All Others	13	64	23	22
Private Sector	13	31	56	16
Potentially Perm - Academe	8	54	38	24
Overall	20	48	32	138

Footnote: All other includes government non-postdocs, temporary academe, and non-profit.

The time spent looking for employment continues to be a weak predictor of job market ratings. Over 75% of Ph.D.s who rated the job market as good found employment within 6 months. However, it took 4 or more months for 60% of Ph.D.s who rated the job market as bad to find work (Table 11).

Table 11. Job Market Ratings by Length of Job Search for New Geoscience Ph.D.s, Class of 2006

Months	Bad %	Neutral %	Good %
Zero	14	36	32
1-3	26	27	27
4-6	39	17	25
6+	21	20	16
Overall	28	66	44

Footnote: Ratings of the job market use a 5-point scale from hopeless to excellent.

FINDING EMPLOYMENT

New geoscience Ph.D. recipients concentrated their job search within academe, and most (62%) want to work in academe in 10 years. Fewer Ph.D.s searched for or have a long-term desire to work in government, industry, or other sectors of the economy (Tables 12 &13). On average, Ph.D.s looked for employment in fewer than two sectors (1.76), reflecting the possibility that they have a strong idea where they want to work (Table 12).

Table 12. Employment sectors in which New Geoscience Ph.D.s looked for employment, Class of 2006

Sector	Number
Academe	123
Government	68
Private Sector	47
Non-profit and Other	30
Total Number	**152**

Footnote: Respondents were asked to check at that apply.

Table 13. Employment Sectors desired in 10 years by New Geoscience Ph.D.s, Class of 2006

Sector	Ph.D.s %
Academe	62
Private Sector	12
Government	11
Non-profit and Other	2
Not sure	13
Total Number	**145**

Ph.D.s take advantage of a variety of job search resources. Informally consulting with peers and colleagues continues to be one of the most often cited and most effective search methods (Tables 14 &15). This is especially effective for postdocs (32%) and Ph.D.s in the private sector (44%). Society publications and mentors or advisors are also widely used, although advisors are slightly less effective. Society publications were the most effective (54%) for Ph.D.s accepting potentially permanent academic positions. On average, Ph.D.s used 3 search methods. For all new geosciences Ph.D.s, none of the methods were overwhelmingly more or less effective than the others.

Table 14. Job Search methods of New Geoscience Ph.D.s, Class of 2006

Method	Number
Informal Channel	94
Society Publication	93
Mentor or faculty advisor	84
Society Meeting	67
Electronic Sources	61
Met employer through former job	39
Other	10
Total Number	**152**

Footnote: Respondents were asked to check all that apply.

THE MOST REWARDING ASPECT OF MY JOB IS:

"I get paid to: 1) hike around mountains and look for fossils and 2) teach bright, young geology students."

"Knowing I have helped some students think differently about the Earth and how they interact with the environment."

-Comments from Geoscientists in Permanent Academic Positions, Class of 2006

Table 15. Most effective job search methods for new geosciences Ph.D.s, Class of 2006					
	Any Postdoc %	Potentially Perm. Academe %	Private Sector %	All Other %	Overall %
Informal Channel	32	8	44	33	29
Society Publication	19	54	0	10	21
Former Job	13	8	25	14	14
Electronic Source	12	17	13	19	14
Advisor	15	8	13	14	13
Other	9	5	5	10	9
Total Number	75	24	16	21	136

Footnote: All other includes government non-postdocs, temporary academe, and non-profit.

For each career advice resource, more postdocs reported receiving helpful career advice than non-postdocs. As postdoctoral appointments are a stepping stone in academic careers, advisors and societies can direct new postdocs into established career paths. On the other hand, the career paths of Ph.D.s who do not accept postdoctoral positions are much more varied, and therefore advising them about their careers is a greater challenge. Overall, advisors provided the most helpful career advice (Table 16).

Table 16. Sources of Career Planning Assistance Reported by Geoscience Ph.D.s, Class of 2006			
	Helpful Advice		
	Non-postdocs %	Postdocs %	Overall %
Advisor	70	86	78
Society	50	72	61
Department	50	56	53
University	34	45	39
Total	60	78	138

Footnote: Respondents were asked to indicate their opinions on a 5-point scale. This table represents the percent of respondents who selected the three most positive responses.

Several main reasons to restrict job searches were cited by the 83% of Ph.D.s who restricted their search. Preferences to work in certain sectors of the economy and certain geographic areas were the most restricting factors, affecting around 75% of respondents. Sixty percent of Ph.D.s were restricted by family reasons (Table 17).

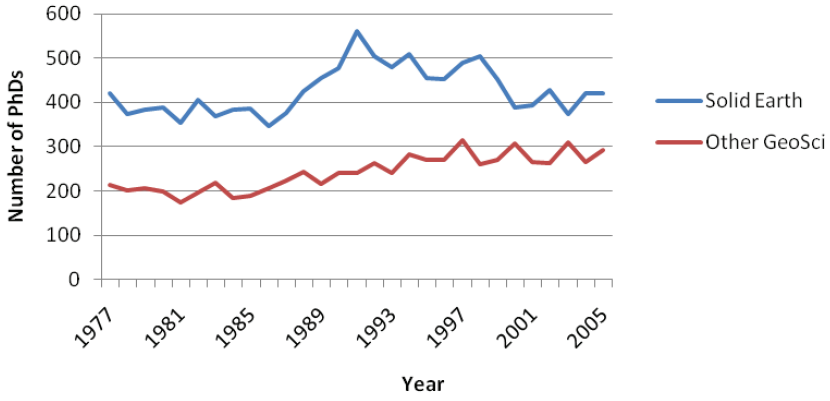
Table 17. How New Geoscience Ph.D.s restricted their job search, Class of 2006	
Restriction	Ph.D. %
To certain sectors of employment	81
For personal preference	78
To certain geographic areas	74
For family reasons	60
Other	39
Did Not Restrict	17

Footnote: Respondents were asked to indicate “yes” or “no” for each item. This table represents responses of "yes".

DEMOGRAPHICS

The NSF reported a total of 713 geoscience Ph.D.s in 2005. The number of Ph.D.s awarded has been fairly stable in recent years. The percentage of geoscience Ph.D.s earning their degrees outside of solid earth sciences (i.e. atmospheric and ocean sciences) increased from a low of 30% in 1991 to around 40% in 1997, where it has leveled off (Figure 3).

Figure 3. Number of Ph.D.s in Solid Earth versus Other Geosciences, 1977 - 2005



Source: NSF Survey of Earned Doctorates
Other Geosci includes atmospheric, ocean, and all other geosciences

Geoscience Ph.D.s are only slightly older than their counterparts in computer science. Compared to other science fields, geoscience Ph.D.s have the highest median age at the time of earning their degree, a consequence of having the longest lag between earning their bachelor's degree and their doctorate (Figures 4 & 5). These differences are less pronounced than previous years, as geoscience Ph.D.s in the class of 2006 are younger and earned their degrees at an average age of 32, as compared to an average age of 32.7 in 2003.

Figure 4. Average Age of Ph.D. recipients by discipline, 2006

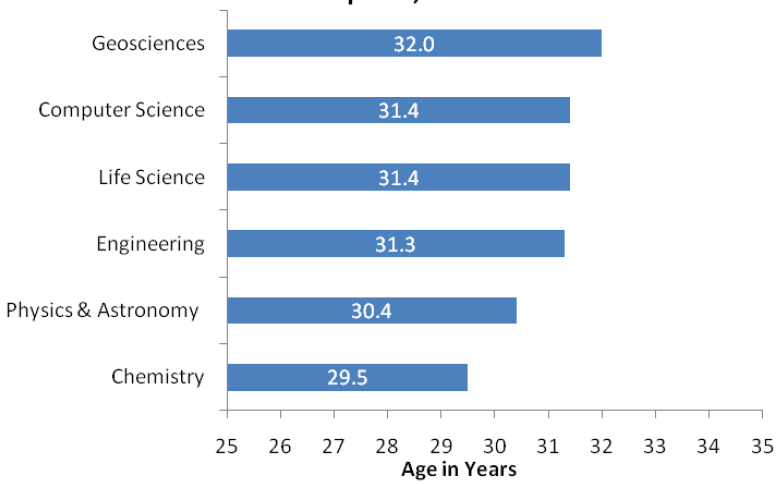
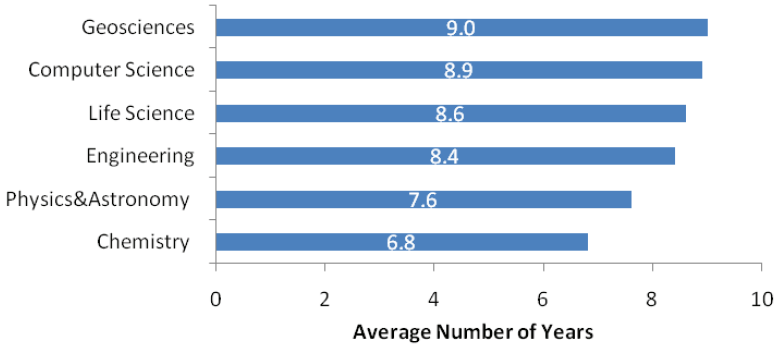


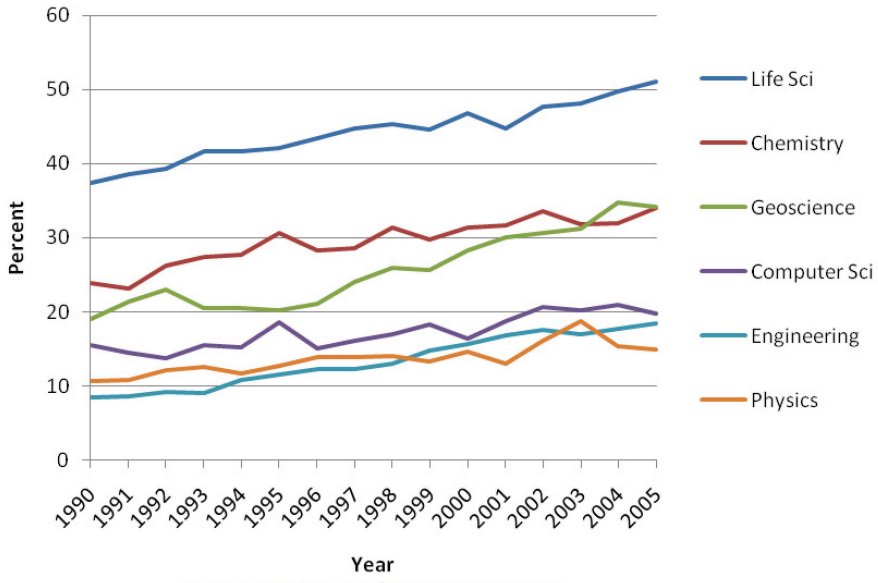
Figure 5. Total time lapsed from baccalaureate to doctorate degree, 2006



Source: NSF Survey of Earned Doctorates

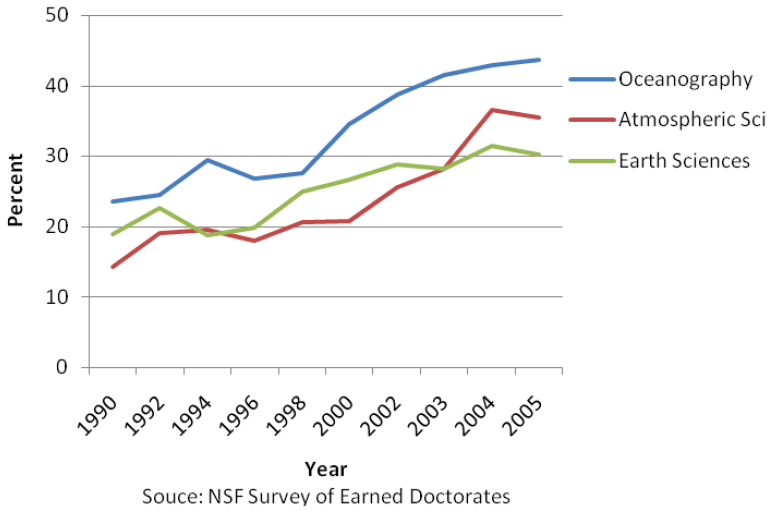
The proportion of women in the geosciences has increased from 19.1% in 1990 to 34.1% in 2005. The geosciences have caught up with chemistry, but both are still short of the equal representation of women in life sciences (Figure 6). More women earn doctorates in oceanography than other geosciences. The proportion of women earning degrees in each of the main disciplines of the geosciences has risen over the last 15 years, though there has been a recent dip in atmospheric and earth sciences (Figure 7).

Figure 6. Proportion of women in Ph.D. class by discipline, 1990-2005



Source: NSF Survey of Earned Doctorates

Figure 7. Proportion of Women Ph.D.s in Geoscience Disciplines, 1990-2005



Souce: NSF Survey of Earned Doctorates

While more men are earning doctoral degrees in geoscience, women earning Ph.D.s in geosciences earn an average salary of $54,600, slightly higher than the average salary for men, which is $49,300 (Table 18). However, with the comparatively small number of respondents providing both gender and salary, these data may slightly exaggerate the salary difference between men and women. Also, men represent a larger proportion of postdocs, who earn the least, further lowering the average salaries for males.

Table 18. Salary by Gender for New Geoscience Ph.D., Class of 2006

	Average $	Typical Salary $	Ph.D. N
Female	**54,600**	**45,000-61,500**	**47**
Male	**49,300**	**40,000-55,000**	**75**

Footnote: These data are based on full-time employed Ph.D.s. They do not include individuals who worked full-time for 12 or more months prior to earning their degree.

Typical Salary Range is the middle half of all reported salaries, i.e. one-quarter of the salaries are less than and one-quarter are more than the typical salary range.

New geoscience Ph.D. women rated the state of the job market worse than men, with 23% of women rating it as good or excellent compared to 38% of men rating it as good or excellent (Table 19). Women were 3 times more likely than men to be working in a part-time position, which may contribute to their lower job market ratings.

Table 19. Ratings of Job Market by Gender for New Geoscience Ph.D.s, Class of 2006					
	Job Market Rating				
	Bad %	Neutral %	Good %	Excellent %	Ph.D. N
Female	26	52	19	3	58
Male	16	46	30	8	79

Geoscience Ph.D.s reported that if they could change anything about their graduate education, they would have taken more technical courses in other departments. Though most of the differences between men and women are not significant due to the comparatively small number of respondents, overall, women would change more about their education. On average, women selected 1.25 things they would change compared to men who, on average, selected 1.06 things they would change (Table 20). Women were also more likely to want to change their advisor or the institution from which they earned their Ph.D.s than were men.

Table 20. What New Geoscience Ph.D.s would change about their Graduate Education, Class of 2006		
	Women %	Men %
More technical courses in other depts.	25	24
Advisor	25	12
Institution	22	12
Research Project	14	8
Field	11	18
More non-science courses	11	10
Time off before	5	6
Time off during	2	2
Other	12	14
Nothing	39	31
Footnote: Respondents were permitted to check all that apply		

On average, Ph.D.s belong to more than one society (1.7). AGU had by far the largest representation of members in this survey, followed by GSA and AMS (Table 21).

Table 21. Society Membership of New Geoscience Ph.D.s, Class of 2006	
Society	Number
AGU	120
GSA	52
AMS	19
AAPG	11
SEG	5
ASLO	9
Other	43
Total Number	152
Footnote: Respondents were permitted to check all that apply	

APPENDIX

HOW THE SURVEY WAS CONDUCTED

Between February 2007 and May 2007, requests were sent to 331 U.S. geoscience graduate departments asking them to provide contact information for their recent graduates. Three initial contacts by email asked department chairs to submit information on a webpage created and maintained by the SRC on their secure server. Departments who did not submit online were sent a mailing with a paper submission form. Combining online and paper submissions, we heard from about 200 departments. The original request specified graduates earning degrees between July 2005 to June 2006. However, the survey accepted information from individuals whose degree dates were several months before or after the 2005-06 academic year. According to the NSF Survey of Earned Doctorates, 757 individuals earned degrees in the Geosciences in 2006.

In conjunction with contacting department chairs, AGU sent a mailing to its student members asking those who recently graduated to volunteer to participate in the study. The American Meteorological Society (AMS) sent a similar request to its student members. We received a combined total of about 340 graduates' names from the requests to these two societies.

In total, contact information was collected for 744 masters and 410 Ph.D.s. Between May 2007 and October 2007, these graduates were contacted directly, initially by email and then with a paper mailing, and asked to answer questions about their education, employment, and demographics. All responses were collected through an online survey created and maintained by the SRC. After data verification, there were data for 167 Ph.D.s who earned their degrees between April 2005 and December 2006 and remained in the United States.

FINE FIELDS IN THE GEOSCIENCES

CATEGORY	SUBFIELDS
Atmospheric Science	Atmospheric science Meteorology Climate Studies Global Earth System Science
Hydrology and Environmental Science	Hydrology Water Resources Soil Science Geomorphology
Oceanography	Physical, Chemical, and Biological Oceanography Sea Floor Processes Marine Geology Ocean Engineering Coastal Science Fisheries
Solid Earth Geology	Paleontology Sedimentology Stratigraphy Structural Geology Tectonics Rock Mechanics Paleoscience Glaciology
Chemical Earth Science	Volcanology Petrology Mineralogy Geochemistry
Solid Earth Geophysics	Seismology Economic Geology Exploration Geophysics Other Solid Earth Geophysics
Space Science	Planetary Science Space Physics Aeronomy Astronomy
Other Science and Engineering	Engineering Computer Science Science Education Other Science Public Policy

EARTH AND SPACE SCIENCE
PH.D.S, CLASS OF 2006

AGU