Mid Continent Section AAPG
Tulsa, OK October, 2009

Developing Intellectual Resources in Geosciences

Scott W. Tinker
Director

Bureau of Economic Geology
Jackson School of Geosciences
The University of Texas at Austin
Outline

I. Down to Earth
II. Questions and Data
III. Observations and Ideas
A couple hundred billion stars in the Milky Way galaxy...

A hundred billion galaxies or so in the universe...

It boggles the mind
The least developed countries, as defined by the United Nations General Assembly in 1998, include 48 countries: Afghanistan, Angola, Bangladesh, Benin, Bhutan, Burkina Faso, Burundi, Cambodia, Cape Verde, Central African Republic, Chad, Comoros, Democratic Republic of the Congo, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Guinea, Guinea-Bissau, Haiti, Kiribati, Lao People’s Democratic Republic, Lesotho, Liberia, Madagascar, Malawi, Maldives, Mali, Mauritania, Mozambique, Myanmar, Nepal, Niger, Rwanda, Samoa, São Tomé and Príncipe, Sierra Leone, Solomon Islands, Somalia, Sudan, Togo, Tuvalu, Uganda, United Republic of Tanzania, Vanuatu, Yemen and Zambia. These countries are also included in the less developed regions.

Median Age: 18.2  Total Population: 658 Million  Dependency Ratio: 860.3
The less developed regions comprise all regions of Africa, Asia (excluding Japan), Latin America and the Caribbean plus Melanesia, Micronesia and Polynesia.

Median Age: 24.3  Total Population: 4.86 Billion  Dependency Ratio: 610.7
The more developed regions comprise all regions of Europe plus Northern America, Australia/New Zealand and Japan.

Median Age: 24.3  Total Population: 4.86 Billion  Dependency Ratio: 610.7
Outline

I. Down to Earth

II. Questions and Data

III. Observations and Ideas
In 2030, will developed or developing nations consume more energy and how much of that energy will come from fossil fuels?

Does Earth Science count towards graduation from High School in every U.S. state?

What percentage of kids take an Earth Science class in U.S. High Schools?

In the past 15 years, has the average U.S. university geoscience department increased, decreased, or stayed the same in terms of number of faculty and students?
Questions

- Of the 15 faculty specialties in U.S. university geoscience programs, what percentage of faculty claim Petroleum Geology?

- What percentage of undergraduate geoscience majors actually complete the degree and graduate from U.S. universities?

- In the past 20 years, have the percentage of females enrolled in geosciences in U.S. universities increased, decreased, or stayed the same?
Questions

- Of the identified science and engineering disciplines in U.S. universities, which confers the lowest percentage of minority degrees to minorities?
- Have the number of geoscience students enrolled in U.S. field camp increased, decreased or stayed the same in the past decade?
- In the past 40 years, has the federal funding applied to geosciences in U.S. universities increased, decreased or stayed the same?
Questions

- Who offers more financial aid to U.S. geoscience students: government or industry?
- Do graduating geoscience students from U.S. universities have more or less debt than their peers in the other major sciences?
- Who employs a greater percentage of graduating Ph.D. geoscientists in the U.S.: academe, government, or industry?
Geopolitical Shift
Energy Consumption

2004 – 445 QUADRILLION BTU PER YEAR

Young
NON-OECD 44%
OECD 56%
Old

2030 – 678 QUADRILLION BTU PER YEAR

Young
NON-OECD 60%
OECD 40%
Old

407 Q

Data Source
AGI Survey, 2009
192 Departments, 88% U.S.

All Survey Respondents by Institution Type

- Four-Year University/College: 78%
- Two-Year College: 9%
- Institute: 7%
- Museum: 2%
- Survey: 1%
- Anonymous: 3%

Source: AGI Geoscience Workforce Program
n=192
U.S. High Schools
Is Earth Science Recommended?

U.S. High Schools
Does Earth Science Count Towards graduation?

U.S. High Schools
Is Earth Science Required?

U.S. High Schools
Is Earth Science Required?

Trends are Improving!
16 states strengthened and
3 weakened since 2002
U.S. High Schools
Science Courses


Source: AGI Geoscience Workforce Program, data derived from NCES, *Digest of Education Statistics, 2007*
For the past 26 years, the percentage of high school students taking earth science courses has not exceeded 25%.

Source: AGI Geoscience Workforce Program, data derived from NCES, Digest of Education Statistics, 2007
U.S. Community Colleges Offering Geoscience Programs

Total Number of Community Colleges per State that Offer General Geoscience Programs

Source: AGI Geoscience Workforce Program, data derived from NCES College Navigator.
Several U.S. geoscience departments reported “definite” or “immediate” threats to their viability or future beyond the next three years. No international departments reported this level of crisis.
Universities and Departments
Anticipated Budget Reduction in Next 12 Months

U.S. Respondents; n = 170

- 36% Anticipate No Reduction
- 16% Anticipate 0-5% Reduction
- 21% Anticipate 5-10% Reduction
- 10% Anticipate 10-20% Reduction
- 4% Anticipate 20-50% Reduction
- 1% Anticipate >50% Reduction

Non-U.S. Respondents; n = 17

- 71% Anticipate No Reduction
- 6% Anticipate 0-5% Reduction
- 12% Anticipate 5-10% Reduction
- 6% Anticipate 10-20% Reduction
- 6% Anticipate 20-50% Reduction
- 6% Anticipate >50% Reduction
83% of U.S. geoscience departments expect budget cuts for 2009 and/or 2010. Only 24% of international geoscience departments feel that their future is “possibly” threatened beyond 2011.
Mean Department Size by Faculty and by Students (1994-2007)

# U.S. Universities

## Where do Faculty Come From?

<table>
<thead>
<tr>
<th>School</th>
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<tbody>
<tr>
<td>Massachusetts Institute of Technology</td>
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<td>University of Wisconsin</td>
<td>188</td>
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<td>University of Washington</td>
<td>184</td>
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<tr>
<td>Columbia University</td>
<td>171</td>
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<td>Stanford University</td>
<td>171</td>
</tr>
<tr>
<td>California Institute of Technology</td>
<td>148</td>
</tr>
<tr>
<td>University of California – Los Angeles</td>
<td>143</td>
</tr>
<tr>
<td>Harvard University</td>
<td>139</td>
</tr>
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<td>University of Arizona</td>
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</tbody>
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Table 2.5: Top Ten Degree Granting Institutions of U.S. Geoscience Faculty
(Source: AGI Geoscience Workforce Program)
10 universities have produced 25% of all geoscience faculty in the U.S.

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(Source: AGI Geoscience Workforce Program)
U.S. Universities
Faculty Specialties

Faculty Specialties within Geology
(1999-2008)

Source: AGI Geoscience Workforce Program
U.S. Universities

Faculty Specialties within Economic Geology

Faculty Specialties within Economic Geology (1999-2008)

Percent of Faculty in Discipline

- General Economic Geology
- Metals
- Coal
- Oil and Gas
- Non-Metals

Source: AGI Geoscience Workforce Program
U.S. Universities

Faculty Specialties within Exploration Geophysics

Faculty Specialties within Geophysics (1999-2008)

Source: AGI Geoscience Workforce Program
U.S. Universities

Faculty Specialties within Engineering Geology

Source: AGI Geoscience Workforce Program
Source: AGI Geoscience Workforce Program, data derived from AGI’s Directory of Geoscience Departments
U.S. Universities
Degrees Granted


Bachelor's
Master's
Doctorate

Source: AGI Geoscience Workforce Program, data derived from AGI's Directory of Geoscience Departments
U.S. Universities Graduation Rates

Geoscience Degree Completion Rates and the Price of Oil (1973-2007)

Source: AGI Geoscience Workforce Program, data derived from AGI’s Directory of Geoscience Departments, and http://inflationdata.com/inflation/inflation_Rate/Historical_Oil_Prices_Table.asp
Department of Geosciences, University of Texas

Total Masters

M.A. Degrees, UT Geology

Oil Price

2000 $

$0.00

$10.00

$20.00

$30.00

$40.00

$50.00

$60.00

$0.00
Department of Geosciences, University of Texas
Total Ph.D.s

Oil Price
2000 $
$60.00
$50.00
$40.00
$30.00
$20.00
$10.00
$0.00

Ph.D. Degrees, UT Geology
U.S. Universities
Female Enrollments

Percentage of Degrees Granted to Females in the Geosciences

Source: American Geological Institute, 2008
53% of geoscience degrees were conferred to women in 2007. Women comprise 14% of tenure track faculty in geosciences, compared to 28% for all science and engineering fields.
U.S. Universities
Students in Field Camp

Total U.S. Field Camp Attendance
(1998-2008)

Source: AGI Geoscience Workforce Program, data provided by Dr. Penny Morton, UMN-Duluth
Despite the decline in the number of schools offering field camps, total attendance has increased by 280% over the past 10 years.

Source: AGI Geoscience Workforce Program, data provided by Dr. Penny Morton, UMN-Duluth
U.S. Universities
Funding for Geosciences

Percent of Total Federal Research Funding Applied to the Geosciences (1970-2007)

Source: AGI Geoscience Workforce Program, data derived from NSF/SRS Survey of Federal Funds for Research & Development
U.S. Universities
NSF Funding Rate

Funding of Earth Science NSF Proposals
(1999-2007)

Source: AGI Geoscience Workforce Program, data derived from NSF BIIS Funding Trends
U.S. Universities
NSF Funding by State

Median Annual Funding of Earth Science NSF Awards
(1999-2007)

Source: AGI Geoscience Workforce Program, data derived from NSF BIRS Funding Trends
U.S. Universities
Student Aid

60% Government; 40% Foundations and Industry

Total U.S. Geoscience Student Aid by Degree Level

- 2006-2007: ~$2,500,000
- 2007-2008: ~$2,500,000
- 2008-2009: ~$3,000,000

~8,000 Students
~ $300/student

Source: AGI
U.S. Universities
Student Funding

Student Support in the Geosciences by Sector (2007-2008)

- General Geoscience: 47%
- Petroleum: 8%
- Geophysics: 17%
- Mining: 8%
- Field mapping/camp: 18%
- Other specialties: 1%
- Paleontology: 1%

Source: AGI Geoscience Workforce Program
U.S. Universities
Student Debt Bachelors

Student Debt of Bachelor's Degree Recipients by Field (2003)

Source: AGI Geoscience Workforce Program, data derived from NSF SESTAT 2003 dataset.
The use of National Science Foundation (NSF) data does not imply NSF endorsement of the research, research methods, or conclusions contained in this report. The Commission on Professionals in Science and Technology provided access to these data. CPST is also not responsible for the research, methods, or conclusions in this report.
U.S. Universities
Student Debt Masters

Student Debt of Master's Degree Recipients by Field (2003)

Percentage of Degree Recipients per Amount of Loan

- No debt
- $1 - $10,000
- $10,001 - $20,000
- > $20,000

Source: AGI Geoscience Workforce Program, data derived from NSF SESTAT 2003 dataset.

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U.S. Universities

Employment of Ph.D. Students

Employment Sectors of New Geoscience Ph.D.s

Source: AGI Geoscience Workforce Program, data derived from AGI/AGU Survey of New Geoscience Ph.Ds, Class of 2006.
Outline

I. Down to Earth

II. Questions and Data

III. Observations and Ideas
New Questions

- Why doesn’t Earth Science count towards graduation in every U.S. High School?
- Why don’t more kids take an Earth Science class in High School?
- Why are the number of faculty and students in U.S. university geoscience departments decreasing?
- Given the likely demand for fossil fuels in 2030 and beyond, why has Petroleum Geology gone away as a faculty specialty?
New Questions

- Why don’t more undergraduate geoscience majors complete the degree and graduate in U.S. universities?
- Given that females enrolled in geosciences in U.S. universities have increased in the past 20 years, why are there not more females in academe and industry?
- Why are there not more minorities in geosciences in U.S. Universities?
New Questions

- Why in the world do geoscience majors graduate with more debt than other sciences?!
- Why can’t industry offer more financial aid to U.S. geoscience students than government?
- Why doesn’t industry employ a greater percentage of graduating Ph.D. geoscientists in the U.S. than government or even academe?
Observations and Ideas

- **Fossil fuels will be a major part of 21st Century energy**
  - Let students know that jobs will be challenging, global, and available!

- **Resource price volatility is a given**
  - Recruiting and hiring should be treated like safety; i.e. done annually regardless of the economic cycle

- **The public is hungry for energy information**
  - Volunteer to speak publicly, and often
Observations and Ideas

- High schools need qualified earth science teachers
- Just because you have a degree does not mean you are qualified to teach
- Many baby boomer geologists are retiring
  - Add meaning to your retirement
  - Get certified to teach, and offer your services!
Observations and Ideas

- Women enrollments in geosciences are increasing yet employment lags
  - Focus on the challenges of a dual career
  - Flexibility is key!
- Minority enrollments in geosciences are embarrassing
  - GeoForce!
  - Mentoring
Observations and Ideas

- Geoscience enrollments are growing in developing nations and will eclipse the U.S.
- Geoscience student debt is relatively high
- Petroleum geoscience funding is relatively low
- Hiring of Ph.D.s into industry is relatively low

- AAPG has created a vehicle to support university faculty and student research called PERC-Petrogrants.

- Make PERC part of your annual investment!
Is there a more meaningful issue on which to work for the coming century than global energy?

A career in the energy industry is challenging, rewarding, and at times terrifying!

Let’s get after it!