Date: October 11, 2002
Memo: To Geoscience Departments
From: Leadership of the VGP Committee

Subject: Skills Outlined for Future Petroleum Geologists

The American Association of Petroleum Geologists (AAPG) is an international organization of 30,000 members located in 125 countries. We provide members and geoscience students with a wide range of journals, services and programs. Many of the programs cover training and education. One of the services provided is the Visiting Geologist Program (VGP). This offers faculties and students in geoscience departments with the opportunity to have practicing petroleum geoscientists visit schools and present papers on a wide range of general or specialist topics.

As part of this program, one of our members, Dr . Chris Heath, has surveyed 88 North American and European oil companies to find out exactly what skills young petroleum geoscientists need today. The survey covered 41 sub-disciplines of geology and geophysics, as well as about a hundred other skills related to computer science, mathematics, non-technical topics, soft skills and other related fields.

By tabulating the data and adding a text, VGP has produced the attached summary which **outlines the skills that those wishing to become petroleum geoscientists need to acquire**. The information is offered for your consideration and may augment, not replace, advice provided by faculty. Since geoscience departments play a crucial role in preparing geology and geophysics students for careers in our industry, we thought that you might be interested in the information Dr. Heath has collected.

Dr. Heath has carried out similar studies covering the mining industry, mining and oil service companies, and to a lesser extent geoscience-based public sector and environmental organizations. Should you be interested in these data please refer to the following papers:

- Heath, C.P.M., 2000a, The technical and non-technical skills needed by Canadian-based mining companies: Journal of Geoscience Education, v. 48, n. 1, January, p. 5-18 (also covers the mining service industry).
- Heath, C.P.M., 2002a, Technical, non-technical and other skills needed by Canadian mining, petroleum and public organizations: Journal of the Geological Association of Canada, v. 29, n. 1, March, p. 21-34 (also covers the environmental sector).

Please feel free to contact Dr. Heath at chrisheath@shaw.ca for further information on the surveys. For information on VGP in general, or to arrange a visit to your department by a visiting geoscientist please contact Cammy McKnight at cammy@aapg.org or 888-945-2274 ext 621 (toll free USA and Canada only). More information is on our website: http://www.aapg.org, then click Education, click VGP!

AAPG VISITING GEOLOGIST PROGRAM

Career Advice for Petroleum Geoscience Students

Reference: Heath, C.P.M., 2000, Technical and Non-technical Skills Needed by Oil Companies: Journal of Geoscience Education, V. 48, pp 605-616. (Britain-based data)

Canadian survey results are due to be published by CSPG- Reservoir in late 2002.

American and Canadian data will be merged and possibly published in the AAPG's Horizon. Other references to similar surveys on mining etc. are available upon request.

These data were collected in 1990-2000 from the 29 international companies based in Britain and from 24 Canadian and 35 American based companies in 2000-2001. All completed a 150-question survey. Together, they employed 487,800 people including at least 8650 geoscientists. Subsequent mergers have reduced these figures somewhat.

(•) means that all companies considered the level of competency required was very high, high, or reasonable.

General Background.

1. The recruit evaluation and selection process is now more sophisticated and rigorous.
2. Some of the larger companies have ranked departments locally, nationally or even globally. They have over 3000 departments to choose from and those departments failing to meet corporate standards or needs may be abandoned.
3. Never-the-less, competition for top quality graduates has become intense and global.
4. Should your department not attract oil companies, be prepared to find your own job.
5. The larger companies expect their employees to have higher levels of technical and non-technical skills than their smaller firm counterparts (See referenced paper).
6. Except in Canada, most big companies expect their geoscientists to have a Master's degree at least (Table 1).
7. The smaller the company, the less likely it is to hire inexperienced geoscientists.
8. Service companies do hire Bachelor degree holders for technical jobs although some now find Master's degree holders who are willing to work for them.
9. Companies expect new hires to have some previous oil industry experience.(Table 2)
10. When deciding which department to recruit from, employers evaluate the geoscience curriculum and reputations of the department, university and supervisor (Table 3).

Geoscience Skills.

1. Each company has its own unique requirements, and the scores presented on these tables are averaged scores. (See referenced paper for methodology).
2. Companies prefer 'geoscientists' rather than geologists or geophysicists. (Table 4.).
3. Table 5 shows that companies prefer their petroleum geoscientists to have a mix of geoscientific, computer, non-technical and soft skills. Note that geological and geophysical skills comprise 50-60 % of the skill profile. However, most of these are not easily transferable of the skills to alternative careers outside the oil industry.
4. Table 6 assesses 41 geoscientific skills needed by oil companies in each country. Make sure you acquire as many of those skills marked by dots and, or, those having high scores - at least a dozen if possible.
5. Field and mapping experience is important for the very big firms but is less critical elsewhere outside the mining industry (Table 7).

Computer Skills.

1. Tables 8 and 9 rank 30 computer competences.
2. General computer operation skills are easily transferable to alternative careers.
3. Apart from basic operations, presentation skills and workstation experience are particularly important (and also transferable). Geoscientific interpretation systems experience is valuable but is less easily transferable.

Non-technical and Soft Skills.

1. Until fairly recently, these skills have been under-valued by employers. Geoscience departments have not always stressed the importance of these skills to their students (Table 10).
2. Note the differences in ranking and value between the nations. These might reflect differences in cultural values, beliefs and attitudes. Be sensitive to these.

3. Most of these skills are transferable. Many appear to be interlinked in some manner.
4. Many of the more important (highest scoring) skills appear to be innate. That is, they are part of one's psychological make up. Some may be attributable to one's genes, heritage, culture, ethnic background and other factors.
5. Some of the skills, perhaps up to half of those evaluated, are developed or enhanced through the teaching-learning process. Many departments appear weak in developing teamwork, practical ethics and summarization skills amongst their students
6. Make sure to you demonstrate your strengths in the key attributes in your resume and during interviews.
7. Low scores for such skills as non-native languages, risk taking and entrepreneurial skills etc. seem to be in conflict with one's perception of the needs of the oil industry and international business. The reason for these contradictions are unclear, but may be due to weak executive thought processes, poor recruiting practices or poor management.

Other important skills needed by geoscientists.

1. Larger companies may expect more than one year of university math. Geostatistics and applied math are more important than calculus (Table 11). Geophysicists need two years of calculus as well.
2. Some understanding of business practices and skills will prove very useful both when seeking a job and in one's subsequent career. Economic analysis and project management are particularly important skills (Table 12).

Plans, strategies and other issues.

1. Remember, good positions in oil companies are hard to get and competition is fierce. Therefore, it is essential to think clearly what you want to achieve if hired, and how you want to get there. Express yourself well in your correspondence and interviews. Avoid spelling errors, slang, and bad grammar. Demonstrate that you are keen to contribute and eager to learn. Don't be afraid to say "I don't know".
2. If you are weak in Geoscience (e.g. you have poor grades), you may be able to compensate by demonstrating good computer, non-technical or other skills. Your interview performance and resume content may help here.
3. Try to decide what you want to do with your life. Where do you want to be within 5, 10, and 15 years: Team Leader, President, or Consultant? Then focus on your goals. But remember, new opportunities may emerge that could lead you to change your goals. There is nothing wrong in this, so be sensitive to opportunities.
4. When you join a company, try to take every course you can. These new skills will not only improve your professional competence, but also could become useful transferable skills. Your keenness to develop these new skills will impress your current employer because he/she will interpret this as keenness and enthusiasm: both positive traits.
5. Find a mentor at university (preferably one with industrial experience) and in your company. They will advise you and help you on your way to a satisfying career. Good luck.

C.P.M.Heath, June, 2002 chrisheath@shaw.ca

Table 1. Minimum Education Requirements

Minimum Education – Geologists

Company	B. Sc. %	M. Sc. %	Trend to M. Sc. Min.? Yes %
Britain-based	45	55	93
American	46	54	81
Canadian	91	9	14

Minimum Education – Geophysicists

Company	B. Sc. %	M. Sc. %	Trend to M. Sc. Min.? Yes %
Britain-based	54	46	89
American	51	49	79
Canadian	91	9	14

Table 2. Importance of Relevant Experience

Pre-Hiring Experience	Average Score	Britain-based Cos.	American Cos.	Canadian Cos.
Industry related work experience	73	61	75 •	83 •
Past/Present responsibility (Leadership)	55	58	54	53
Research (Govt. or University)	39	42	41	33
Volunteer Work	33	22	35	42
Non-Industry Related Work	22	21	21	23

Table 3. Importance of Academic Quality

Topic	Britain-based Cos.	American Cos.	Canadian Cos.
Curriculum	67	67	62
Departments & Reputation	67	68	62
University's Reputation	64	64	53
Supervisor's Reputation	48	44	44

Table 4. Companies Preferring a 'Geoscientist' rather than a Geologist or Geophysicist

Company	Score
Britain-based	87
American	81
Canadian	83

Table 5. 'Ideal Mix' of Skills Needed by a Petroleum Geoscientist

Component	Average Score	Britain-based Cos.	American Cos.	Canadian Cos.
Geosciences	54	48	60	55
Computer skills	20	23	17	19
Non-technical and soft skills	26	29	23	26

Table 6. The 41 Most Important Geoscience-Skills Needed

Topic	G=Geophysics M=Multidisciplinary	Avg. Score	29 Britain-based Cos.	35 American Cos.	24 Canadian Cos.
Subsurface Mapping Techniques	M	**86 •**	**85 •**	**85 •**	**88 •**
Sedimentology/Sedimentary Geology		**85 •**	**81 •**	**85 •**	**88 •**
Petroleum Geology		**85 •**	**82 •**	**87 •**	**86 •**
Stratigraphy		**84 •**	**80 •**	**87 •**	**86 •**
Geophysics – Mapping and Interpretation	G	**82**	**81 •**	**80**	**82 •**
Introductory Geophysics	G	**77 •**	71 •	**76 •**	**83 •**
Play Assessment	M	**76**	**82**	70	**77**
Sequence Stratigraphy	M	**75**	74 •	**77**	**75**
Log/Core Analysis (Petrophysics, Log Analysis, FM Evaluation, etc.)	M	73	65	72	**81**
Introductory Structural Geology (Principals & Deformation)		72	67 •	**78**	71
Average scores for top 10 topics		**80**	**77**	**80**	**82**
Reservoir Geology (Including Reserve Estimates, Modelling)		71	74 •	70	70
Basin Analysis/Hydrocarbon systems	M	69	73 •	69	66
Reflection & Refraction Seismic – Principals	G	64	62	59	71
Regional Geology (basin system, region, country, orogenic belt, etc.)		63	71	61	57
Petroleum Economics		53	35	61	62
2-3D Seismic Modelling and Mapping	G	61	65 •	69	74
Sedimentary Structures		60	56	56	69
Applied/Operations Geophysics (Methods & Acquisition)	G	59	67	57	54
Operations Geology		59	51	63	63
Advanced Structural Geology (structural analysis, complex structs., etc.)		58	53	65	57
Average scores for next 10 topics		**62**	**61**	**63**	**64**
Rock : Fluid Interaction		54	50	53	58
Special rock studies (carbonates, clastics, shales, evaps, etc.)		53	49	50	61
Organic Geochemistry		51	60	48	45
Geophysics – Inversion	G	50	43	52	52
Plate Tectonics/Geodynamics		48	54	50	41
Global Geology/Geology of the World		47	47	50	45
Biostratigraphy		54	50	53	58
Field Skills & Mapping		44	44	44	43
General Geochemistry		44	43	43	47
Potential Fields (Gravity & Magnetics)	G	43	40	43	45
Average scores for next 10 topics		**49**	**48**	**49**	**50**
Petrology/Petrography		43	42	43	45
Time : Series Analysis	G	40	36	45	40
General Paleontology		37	34	39	39
Marine Geology/Geological Oceanography		32	36	27	23
Environmental Geology		32	36	22	39
Micropaleontology (Forams, Ostracods, etc.)		31	33	35	25
Recent, Quaternary & Surficial Geol. (Fluvial, Lacustrine, etc.)		30	20	31	38
Geomorphology		30	20	33	37
Terrain Analysis (Remote Sensing, Air Photography, etc.)	M	29	25	25	38
Palynology		27	31	29	21
Coal		20	16	22	21
Average scores for bottom 11 topics		**35**	**33**	**35**	**37**

Note: **- 85** = important scores (75 or higher).

Table 7. Importance of Field and Mapping Experience

	29 Britain-Based Cos.	35 American Cos.	25 Canadian Cos.
Number of days preferred	61	56	58

Table 8. Computer Skills Needed by Geoscientists

General Computer Operations	Average Score	29 Britain-based Cos.	35 American Cos.	24 Canadian Cos.	Overall Top 10.
Basic					
- Electronic Communication (e-mail)	**73**	**74**	**71**	**71•**	1
- Spreadsheets (Lotus, Excel, etc.)	**70**	**76**	**61**	**72•**	2
- Desktop Systems (Windows 95, 98, 2000 Macintosh, etc)	**70**	**73**	**69**	**67•**	2
- Word Processing (Word, WordPerfect, etc.)	**67**	**66**	**68**	**67•**	4
Exposure to Computer hardware					
- P.C.	**65**	**66**	**68**	**61**	5
- Workstation skills only	59	**61**	**63**	53	8
- Unix	53	**61**	**60**	37	10
- Peripheral Equipment	44	40	48	43	
Graphics					
- Presentation (PowerPoint, etc.)	**60**	**61**	**62**	58	7
- Advanced (Corel Draw, etc.)	34	32	28	42	
- Drafting (AutoCad, Visio, etc.)	20	20	22	17	
Internet					
- Searching (www, Yahoo, etc)	55	52	58	54	9
- Application (accessing indexes, FTP, TelNet, etc.)	39	39	46	31	
G.I.S.					
- Simple (ArcView, Map Info, etc.)	42	43	46	38	
- Advanced (Arc Info, Spans, etc.)	28	23	36	25	
- Assisted Modelling (Fuzzy Logic, Weights of Evidence, etc.)	25	18	30	16	
Databases					
- Simple (FoxPro, Access, D'Base, etc.)	34	34	39	30	
- Advanced (Oracle, etc.)	28	27	33	24	
- Design and Management	17	15	20	17	
Programming					
- Introductory (C++, Fortran, html, etc.)	15	19	16	11	
- Advanced (C++, Fortran, html, etc.)	13	19	12	8	

Table 9. Geoscience Specific Operations

	Average Score	29 British-based Cos.	35 American Cos.	24 Canadian Cos.	Overall Top 10
Geoscientific Interp. Systems (Landmark, Promax, etc.)	**62**	**61**	**63**	**63**	6
Geophysical Modelling (Seis. & Potential Field Data)	51	49	44	59	
Resource/Reserve Calculations (GSLIB, etc.)	47	51	45	44	
Geophysics Processing (Geosoft, ER Mapping,etc.)	46	47	42	49	
Statistical Data (SAS, etc.)	45	47	51	38	
Geological Modeling (PC-Xplr, Rockware, etc.)	44	45	46	42	
Exploration & Mapping Packages (Vulcan,Datamine, etc.)	36	32	38	39	
Remote Sensing (Terrascience, Arc Grid,Rockware, etc.)	33	19	21	40	
Geochemistry –Applications (Paradox,Excel, etc.)	27	40	33	20	
Geochemistry – Spatial (Geosoft, Arc View,Surfer, etc.)	26	28	28	23	

Note: - **65** = important topics (60 or higher).

Table 10. 36 Non-Technical & Soft Skills Needed

Ranking	Skill or Attribute	Average Score.	28 Britain-based Cos.	35 American Cos.	24 Canadian Cos.
1	Initiative	**90**	**89**	**89**	**91**
2	Ethics/Integrity	**89**	**90**	**90**	**87**
2	Critical Thinking/Ability to Think	**89**	**x**	**90**	**88**
4	Willingness to Learn	**88**	**86**	**88**	**89**
5	Commitment	**87**	**88**	**87**	**85**
5	Desire to Achieve/Motivation	**87**	**87**	84	**89**
5	Drive/Energy/Enthusiasm	**87**	**87**	81	**94**
8	Dependability/Reliability	**85**	**86**	**86**	82
8	Oral Communication	**85**	**88**	84	**88**
8	Creativity/Out of Box Thinking	**85**	79	83	**93**
	Average scores for top 10 attributes	**87**	**87**	**86**	**89**
11	Analytical Ability	84	84	83	**85**
12	Can Cope with Stress	83	**85**	79	**85**
12	Self-Management/Taking Responsibility	83	84	**85**	80
12	Problem Solving	83	81	81	**87**
12	Can Summarize Key Issues/Abstract	83	**87**	80	83
16	Cooperation	82	**86**	81	78
16	Adaptability/Flexibility (Job, location, organization, etc.)	82	**87**	79	79
16	Teamwork	82	80	80	**85**
19	Self-Reliance/Independence	81	80	76	**87**
20	Listening	80	79	78	83
	Average scores for next 10 attributes	82	83	80	83
21	Can Overcome Adversity	78	75	77	82
21	Logical Argument/Reasoning	78	80	74	81
23	Time Management	77	79	75	78

Ranking	Skill or Attribute	Average Score.	28 Britain-based Cos.	35 American Cos.	24 Canadian Cos.
24	Written Communication	76	77	76	76
24	Spatial Thinking/3D Visualization	76	70	78	81
24	Self Confidence	76	76	71	79
27	Enquiry/Research Skills	75	74	70	82
28	Rapid Conceptualization of Issues	73	72	69	78
29	Leadership	68	70	65	70
30	Risk Taker	66	60	67	72
	Average scores for next 10 attributes	74	73	72	78
31	Entrepreneurial Flair/Skills	65	65	59	72
32	Intellectual Ability (e.g. Good Grades, Cum Laude, Honors etc.)	63	66	62	61
33	Cultural Awareness	60	66	57	57
34	Numeracy (e.g. 2 Years of University Math/Statistics, etc.)	52	59	50	46
35	International Living/Travel	44	54	43	35
36	Non-Native Languages	40	48	40	31
	Average scores for bottom 6 attributes	32	36	31	30

Notes: **- 90** = Important attributes (85 or higher).
- (•) Symbol was not applied.
- x = Not covered in British survey

Table 11. Other Education Factors Considered by Employers

Math Education	Average Score	29 Britain-based Cos.	35 American Cos.	24 Canadian Cos.
1 Year of Geostatistics	48	48	54	43
Applied Math	44	45	48	39
Classical Statistics	43	42	45	42
Linear Algebra	40	x	46	34
1 year of Calculus	37	28	48	36
Matrix Algebra	33	x	36	29
2 years of Calculus	30	24	35	30
Partial Differential Calculus	28	x	32	24
2 Years of Geostatistics	28	31	29	24
Advanced Geostatistics (Kriging, Variograms, etc.)	26	30	26	23

Note: - 65 = important scores (60 or higher).
- x = **not covered in British survey.**

Table 12.

Business Education	Average Score	29 Britain-based Cos.	35 American Cos.	24 Canadian Cos.
General Awareness Only	**61**	57	**62**	**65**
Economic Analysis	56	52	55	**62**
Project Management	54	53	55	54
General Business Courses	50	47	50	52
Planning/Strategy	49	50	47	49
Finance/Budgeting	38	47	43	24

Note: - 65 = important scores (60 or higher).