THE PRACTICE OF THE PROFESSIONS OF GEOLOGY AND GEOPHYSICS

SECOND EDITION

MARCH 1990

APEGGA's Mission

To serve society by regulating, enhancing and providing leadership in the practice of the professions of engineering, geology and geophysics.

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SECOND EDITION

MARCH 1990

Edited and compiled on behalf of the Professional
Practice Examination Committee of the Board of Examiners
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Preface

This publication is intended as a specific study document for geologists and geophysicists writing the APEGGA Professional Practice Examination. As such, the first edition was approved by the Board of Examiners in June 1985, and approved by the Council of APEGGA in October 1985 as an official APEGGA document for general distribution.

The second edition is basically an update of the first. In Chapter 1 some comments about terms "earth science" and "geoscience" have been added, and Engineering Geophysics has been included as a branch of geophysics. The history of the Alberta legislation, Chapter 2 has been updated to include discussion of CSEG/CSPG/APEGGA Liaison committee activities. In Chapter 3, the last section on registration in other Canadian jurisdictions has been expanded to cover developments in Newfoundland, Yukon, British Columbia, Saskatchewan and Quebec. The main changes in Chapter 4 on registration concern changes in legislation (awaiting government approval as of March 1990) to reflect raised entry standards to the examination route and a discussion of the development of revised geology and geophysics examination syllabi.

In Chapter 5, Professional Practice, the section on ethics has been revised to refer to the APEGGA 1987 Code of Ethics and the 1989 Manual of Professional Practice under the Code. Articles by David T. Irving, P. Eng. and James M. Dunn, CPG have been added. Chapter 6 and 7 reflect a general updating; the discussion on registration in the USA covers legislation for five additional states that now have geologist registration boards. There is no Chapter 8 in this edition.

Applicants for registration as Professional Geologists and Professional Geophysicists are reminded that there are also other references for the Professional Practice Examination, and that the syllabus includes topics additional to what is contained in this publication. Examples are:

- the Act, Regulations and Bylaws;
- the role of the engineer, geologist and geophysicist in society;
- public responsibility, discipline;
- occupational health and safety, workers' compensation;
- law and professional liability;
- contracts: formation, grounds upon which a contract may be impeached, interpretation, discharge, breach, specific types; and
- the engineer, geologist and geophysicist as an expert witness.

Complete details are contained in the information sheet: "Instructions for Candidates".

The editor wishes to thank those members whose writings contributed to this publication, who reviewed the original draft manuscript and provided valuable comments: Roy Lindseth, P. Geoph., Jack Browning, P. Geol., Gordon Williams, P. Geol., Peter Dordy, P. Geol., George Woollett, P. Geol., and Jim Mume, P. Geoph. Thanks also to John Wolfe, Executive Secretary, California State Board of Registration for Geologists and Geophysicists who reviewed Chapter 7; to the Canadian Societies of Exploration Geophysicists and Petroleum Geologists, and to the several Canadian and American organizations and individuals who gave their kind permission to reprint or utilize articles and other documents. Finally, but not lastly, my appreciation to Sharon Lindgren, Barbara Robinson and Zena Allen of APEGGA staff who typed and formatted this second edition on the Association's recently acquired desk top publishing equipment.

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Chapter 1
The Nature of Geology and Geophysics

General

1.1 Geology and geophysics, geology in particular, are sciences which have traditionally been concerned with a study of the earth. Geology relates to the solid earth itself, and geophysics to the physical properties of the earth and its atmosphere.

1.2 Besides these two, there are other sciences connected with studying the earth and its environment. Examples are: oceanography (the oceans), meteorology and climatology (the atmosphere), pedology (the soil), and space and planetary sciences (outer atmosphere and space). Although there has been a relatively close interaction between geology and geophysics – fostered in part by exploration and development of petroleum and other mineral resources – most of these other sciences have tended to be somewhat isolated from one another. But in recent years this long and artificial separation has been disappearing – scientists engaged in studying the earth came to appreciate similarities and interactions in their studies.[1] Consequently in the past few decades all of these sciences came to be classified as "earth sciences" or, more recently, the "geosciences". For example, according to one author: "Earth science is a blanket name for all the sciences that collectively strive to understand the earth and its space neighbours".[2]

1.3 Grouping the several sciences involving the earth and its environment under a common broad classification led to the formation of organizations having "earth science" or "geoscience" in their title. One such organization is the Canadian Geoscience Council (CGC) founded in 1972 (see chapter 6).

1.4 The importance of the earth sciences or geosciences to society and humankind is well-expressed in the Canadian Geoscience Council's careers booklet.[3] Some portions are reproduced below.

> **Earth scientists have the responsibility of finding new mineral resources for the economic development of all nations, both rich and poor. They have to contribute to the protection of the planet and its resources by looking at soil deterioration, at the cost and location of structures, to determine sources and management of water supplies, to provide adequate energy resources, and to see that waste products are managed or stored so that they pose a minimal threat to planetary ecosystems. They also contribute a vital component to the understanding and prediction of natural hazards and disasters, including earthquakes, landslides, volcanic eruptions, floods, droughts and tidal waves.**
>
> **A modern industrial society such as Canada depends directly on the availability of natural resources and the ability to process those resources. In turn, the discovery and development of earth resources depends directly on the skills of geoscientists.**
>
> **Humans have come to reassess their role in the geological environment. Many questions have been raised which are of direct relevance to the earth sciences. For example, where should radioactive and chemical wastes be disposed? What is the environmental impact of a new mine? Should quarrying be done in a beautiful escarpment or should construction aggregates be obtained from more distant sources, thereby using up more energy and contributing to global warming? Is it possible to assess the computer-predicted degree of climate warming by examining proxy environmental data? Can a watershed support a large park area and tourist**

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1 **Lee, McAllister A., *An introduction to the Geological and Geophysical Sciences*, (Prentice Hall, Englewood Cliffs, N.J., 1973) p. 3.**

2 **Henry Lepp, *An Introduction to Earth Science*, (McGraw Hill, 1973), pp. 2.3.**

3 **Canadian Geoscience Council, *Careers in Geoscience* booklet, Third Edition, 1990. With permission of the Council.**

visits without permanent disruption or damage? What are the full environmental consequences of river diversion in order to service human needs? Such questions result in decisions made or influenced by geoscientists.

1.5 Notwithstanding the increasingly common usage of the general terminology, geology and geophysics continue to be considered as two specific and major fields of endeavour by many scientific and professional organizations, including APEGGA. This is the philosophy inherent in this publication, and it should be kept in mind that usage of the terms "earth science" and "geoscience" apply to other fields, (or sciences, or disciplines), as well as geology and geophysics.

Geology[1]

1.6 From the dawn of the stone age accelerating with the discovery of metals, man has been dependent on his mineral resources. Today, the economy is based more than ever before on the earth's natural mineral resources. The increasing awareness of man's dependence on these natural resources eventually led to a fascinating and vital new science - geology, the science of the earth.

1.7 The word geology is literally self-defining, for it is derived from the Greek "geo" (earth) plus "logos" (study). Unlike such sciences as astronomy, mathematics and physics, geology as known today has developed during the past three hundred years. The word itself was coined less than two hundred years ago.

1.8 Through the Renaissance, the basic tenets of geology were slowly evolving. But this progress was sporadic, consisting of scattered and often unrelated observations. Certain geologic principles had been recognized, but they had not been clearly defined or related to each other, and geology lacked a basic unifying concept that might give it the status of a true science. In 1795, this unifying concept was provided, when James Hutton published the book "Theory of the Earth, with Proofs and Illustrations". Clarified by John Playfair, Hutton's principle of Uniformity of Process became the basis of most geologic interpretation and one of geology's contribution to modern scientific thought.

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[1] W.H. Matthews III, *Invitation to Geology - The Earth Through Time and Space*, (Natural History Press, New York, 1971), pp. 2 - 3, 9, 13, 15, 19, 21.

1.9 Geology continued to develop in the 1800s and beyond. An earth sciences encyclopedia states: "During the twentieth century the skills of the geologist have been in constant demand and the geological profession has expanded enormously. The technology basic to modern society lays strenuous claims upon all manner of materials locked into the earth's crust, and the discovery of these materials has become one of the prime tasks of the Earth Scientist."[5]

Geophysics

1.10 The term "geophysics" first appeared in 1853 when a German lexicon used it as a substitute for the term "earth physics".[6] According to Matthews, geophysics is an "in between" field that employs the techniques and concepts of both physics and geology. Another text designates geophysics as "the study of the earth using physical measurements at or above the surface" and comments as follows: "Geology involves the study of the earth by direct observations on rocks, either from surface exposure or boreholes, and the deduction of its structure, composition, or history by analysis of such observations. Geophysics, on the other hand, involves the study of those parts of the earth hidden from direct view by measuring their physical properties with appropriate instruments, usually on or above the surface. It also includes interpretation of the measurements to obtain useful information on the composition and structure of the concealed zones."[7]

1.11 The Canadian Society of Exploration Geophysicists (SEG) describes geophysics as follows: in applying the principles of physics, it is the science that studies the physical properties of both the interior of the earth[8,9] and the properties of the atmosphere. The properties of the earth's interior that are measured include the travel time and velocity of seismic energy (motion) through the earth, rock density, magnetic field, electrical properties, radioactivity and others. The results of these measurements are used to:

1. locate stable areas for the construction of dams and buildings;

2. determine the location and strength of earthquakes;

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5 David G. Smith, Ed., *The Cambridge Encyclopedia of the Earth Sciences*, (Cambridge University Press, New York, 1981), p. 22.

6 Bates, Charles C., Gashell, Thomas F. and Rice, Robert B., *Geophysics in the Affairs of Man*, (Pergamon Press, Oxford, 1982), p. 3.

7 Milton G. Dobrin and Carl H. Saint, *Introduction to Geophysical Prospecting*, (McGraw-Hill, New York, 1988), pp. 1.2.

8 See footnote 3.

9 Canadian Society of Exploration Geophysicists (CSEG), *Careers in Geophysics in Petroleum and Mining Exploration*, 1986, 12 pp.

3. explore the recoverable resources of

   a) petroleum and natural gas
   b) minerals
   c) fresh water and
   d) geothermal reservoirs;

4. study the internal structure of the earth; and

5. study the evolution of the earth.

Geophysical investigations of the atmosphere extend to the exosphere and beyond, but this aspect of geophysics is outside the scope of Alberta practice (see paragraph 1.12 below).

Formal or Legal Definitions

1.12 The Engineering, Geological and Geophysical Professions Act defines the practices of geology and geophysics as follows:[10]

'Practice of Geology' means:

reporting, advising, evaluating, interpreting, geological surveying, sampling or examining related to any activity

(a) that is aimed at the discovery or development of oil, natural gas, coal, metallic or non-metallic minerals, precious stones, other natural resources or water or that is aimed at the investigation or geological conditions, and

(b) that requires in that reporting, advising, evaluating, interpreting, geological surveying, sampling or examining, the professional application of the principles of the geological sciences.

'Practice of geophysics' means:

reporting on, advising on, acquiring, processing, evaluating or interpreting geophysical data, or geophysical surveying that relates to any activity

(a) that is aimed at the discovery or development of oil, natural gas, coal, metallic or non-metallic minerals or precious stones or other natural resources or water or that is aimed at the investigation of subsurface conditions in the earth, and

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[10] *Engineering, Geological and Geophysical Professions Act*, Chapter E-11.1, Revised Statutes of Alberta, 1981, as amended to December 1985, Section 1(n), (o).

(b) that requires in that reporting, advising, evaluating, interpreting, or geophysical surveying, the professional application of the geophysical sciences.

These definitions were developed in 1980-81 by the APEGGA Act and Bylaws Committee during drafting of the new Act. The Committee had representation on it from senior geologists and geophysicists, and input was received from the geological and geophysical membership of APEGGA during the approval process through Council and the membership.

1.13 It is worth noting that both definitions refer to "the professional application of the geological/geophysical sciences". In this sense, the geological sciences can be considered as subdivisions of geology, such as mineralogy, petrology, paleontology, geomorphology, structural geology. Subdivisions of geophysics include atmosphere physics, hydrosphere physics, solid earth physics, of which the latter subdivision can be further broken down into seismology, geoelectricity, tectonophysics etc.

1.14 The definitions have both similarities and differences. Subsections (a) of both definitions, which describe the "activities" involved in practising geology or geophysics, are similar in that both refer to the discovery or development of:

- oil
- natural gas
- coal
- minerals (both metallic and non-metallic)
- precious stones
- water
- other natural resources

In other words, both geologists and geophysicists are concerned with these specific resources, and with both the *discovery* and *development* of them. Another similarity between the two definitions is the final phrase in subsection (b) - :"that requires in the ... (performing) ... the professional application of the principles of the geological (in the case of geology) and of the geophysical (in the case of geophysics) sciences." Hence a formal education is required to legally practice geology and geophysics - the practice cannot be carried out by those not appropriately educated and trained - and this is consistent with treating geology and geophysics as professions.

1.15 Further examination of the definitions contained in the Act shows some dissimilarities i.e. there is one activity which is distinct for each profession, and that what geologists do is sometimes different from what geophysicists do:

	Geologists	*Geophysicists*
Activity	that is aimed at the investigation of	that is aimed at the investigation of subsurface

	geological conditions.	conditions in the earth.
What is done	reporting	reporting on
	advising	advising on
	evaluating	acquiring] geophysical data
	interpreting	processing
	geological surveying	interpreting
	sampling	geophysical surveying
	examining	

1.16 The definitions of practice include also the teaching of geology and geophysics at a university. In 1983-84 this inclusion generated some concern among university academic staff who came to view the requirement as an encroachment on academic freedom and interference with university hiring practices. The outcome was an additional clause exempting from the practice of the profession a person whose work consisted *exclusively* of teaching geology or geophysics at a university, but "teaching" continued to be specified in the definition.[11]

Are Geology and Geophysics Also Professions?

1.17 Most geologists and geophysicists regard their calling as a profession. Some, while viewing these sciences as professions, either do not feel their professions should be legally recognized or if legally recognized, they see no need to belong to it. While this question is examined in more detail in Chapter 3, a short discussion on the meaning of the term "profession" is in order at this stage.

[11] *Engineering, Geological and Geophysical Professions Amendment Act, 1984*, Chapter 17, Sections 5 (2)(e) and 7 (2)(e).

1.18 There are various definitions of the word "profession" in the literature. For example, according to Webster's Unabridged Dictionary, a general meaning is "A calling requiring *specialized knowledge* and often long and *intensive preparation* including instruction in skills and methods, maintaining by force of *organization* or concerned opinion *high standards of achievement and conduct*, and committing its members to *continued study* and a kind of work which has for its prime purpose the rendering of a *public service*."[12]

1.19 Wickenden in "The Second Mile", in listing the attributes of the corporate life of a group of persons as professional in character, states a similar meaning:[13]

1. A body of knowledge (science) and of art (skill) held as a common possession and to be extended by united effort;

2. An educational process based on this body of knowledge and art, in ordering which the professional group has a recognized responsibility;

3. A standard of personal qualifications for admission to the professional group, based on character, training and proved competence;

4. A standard of conduct, based on courtesy, honour and ethics, which guides the practitioner in his relations with clients, colleagues and the public;

5. More or less formal recognition of status, either by one's colleagues or by the state, as a basis for good standing; and

6. An organization of the professional group, devoted to its common advancement and its social duty, rather than to the maintenance of an economic monopoly.

1.20 The Alberta Government report on the professions and occupations referred to the traditional definition of a profession as "an occupation that properly requires a liberal arts education (the higher branches of learning enhancing the languages, history, science and philosophy) or its equivalent and mental rather than physical labour".[14] The report also states that "the professions are quite conscious of the designation as a 'profession' and have invariably interpreted it to mean a branch or field of endeavour which for ideal performance, requires an advanced degree of aptitude, ability, specialized training, responsibility, conscientiousness, self-discipline and ethical maturity".

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[12] Referred to in John Dustin Kemper, *Engineers and Their Profession*, Fourth Edition, (Saunders College Publishing, a division of Holt, Rinehart and Winston, 1990), p 8.

[13] William E. Wickenden, "The Second Mile", *Alberta Professional Engineer*, November 1963, p. 14.

[14] Select Committee of the Legislative Assembly, Alberta, *Report II on Professions and Occupations*, December 1983, p. 4.

1.21 A third definition, which is oriented towards the individual and which is contained in legislation, is the definition of a professional employee in the U.S. Taft-Hartley law:[15]

> The term 'professional employee' means -
>
> (a) any employee engaged in work
>
> (i) predominantly intellectual and varied in character as opposed to routine mental, manual, mechanical or physical work;
>
> (ii) involving the consistent exercise of discretion and judgement in its performance;
>
> (iii) of such a character that the output produced or the result accomplished cannot be standardized in relation to a given period of time;
>
> (iv) requiring a knowledge of an advanced type in a field of science or learning customarily acquired by a prolonged course of specialized intellectual instruction and study in an institution of higher learning from a general academic education or from an apprenticeship or from training in the performance of routine mental, manual or physical processes; or
>
> (b) any employee who
>
> (i) has completed the course of specialized intellectual instruction and study described in clause (iv) of paragraph (a), and
>
> (ii) is performing related work under the supervision of a professional person to qualify himself to become a professional employee as defined in paragraph (a).

1.22 There are numerous other definitions and meanings of "profession" as well as those described above, but most of these have common characteristics which consistently appear. To illustrate, the following is an excerpt from APEGGA's Manual of Practice:[16]

> A profession is a learned calling with specialized skills, distinctive functions and recognized social obligations and has unique characteristics.
>
> - It renders services based upon advanced knowledge, skill and judgement.

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[15] Quoted in John Dustin Kemper, *Engineers and Their Profession*, Fourth Edition, (Saunders College Publishing, a division of Holt, Rinehart and Winston), Copyright 1990 Saunders College Publishing. Reprinted with permission.

[16] *Manual of Professional Practice under the Code of Ethics*, APEGGA publication, First Edition, 1990.

- It is charged with a substantial degree of public obligation and performs its services largely in the general public interest.
- It is bound by a distinctive ethical code in its relationships with clients, employees, colleagues and the public.
- It assumes responsibility for actions related to professional services provided in a personal or supervisory capacity.

Professions such as engineering, geology and geophysics are generally highly organized; they have definitive standards of admission (which are minimum standards only and make no distinction between the least competent persons and the outstanding leaders of the profession); they regulate the activities of their members; they promote the advancement of knowledge, skill and experience; and they encourage the formulation of standards. While professionals should be fairly remunerated for their services, their members are expected to put service above gain, excellence above quantity, rewards of self-expression above any pecuniary incentive, and a code of honour above competitive spirit.

1.23 In comparing the definitions of geology and geophysics with the definitions of a "profession", it is evident that both can be regarded as professions. However, in the case of geophysics, the degree to which that profession has satisfied one of the characteristics - protection of the public interest - has sometimes caused some difficulty (see Chapter 3).

1.24 Organized geosciences associations and societies treat geology and geophysics as professions. Statements in the literature of the American Institute of Professional Geologists (AIPG) clearly show the status of the geology profession accorded by this organization: "The purpose of the Institute shall be: to strengthen the geological sciences as *a profession* ...": "AIPG remains dedicated to communicating to the public and to its representatives the importance to society of the *profession of geology*": "AIPG strives to promote awareness of the *profession of geology* and contends that professional geological work provided to the public should be undertaken by qualified geologists": "It is in the best American tradition for *members of a profession* to group together in an association": "Geology is both a science *and a profession*."[17] The Society of Exploration Geophysicists (SEG) requires, for membership, the applicant's work to have been of a *professional* nature for not less than the eight years of *professional* experience; its Code of Ethics contains statements such as "It shall be your duty as a geophysicist, in order to maintain the dignity of *your chosen profession*: to ... carry on your *professional* work ... cooperate in building up the geophysical *profession* ...".[18] The State Board of Registration for Geologists and Geophysicists, California was given specific authority to "regulate the geology and geophysics *professions* ..." under the California Act. The Board of Registration for Professional Geologists, State of Idaho, begins its Code of Ethics with the sentence "*Geology is a profession*, and the privilege of professional practice requires

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[17] American Institute of Professional Geologists, *1989 Membership Directory*, introductory information, pp. 1, 2, 27.

[18] Society of Exploration Geophysicists, Tulsa, Oklahoma, U.S.A., application forms and other general information, 1989.

morality and responsibility, as well as *professional knowledge*, on the part of the practitioner."[19]

1.25 Remarks by a U. S. consulting geologist, Wallace E. Pratt, on the certification of professional geologists are noteworthy in referring to geology as a profession:[20]

> **Although petroleum geologists have long devoted themselves with commendable zeal to their science, represented by the American Association of Petroleum Geologists, most of those employed by the oil industry have in the past manifested only an indifferent attitude toward geology as a profession. Only within the last few years have petroleum geologists begun to realize that they constitute a profession, as well as a science; and that their profession demands of them the same loyalty they have long rendered to their science.**
>
> **But do we all agree that petroleum geology is a profession as well as a science? The term professional has been defined authoritatively as an occupation based on an art, a science, or other branch of learning, in which each of those who engage in it professes to be skilled, experienced, and competent - capable of applying his profession constructively to the affairs of others. Divinity, medicine, and law have long been recognized as three learned professions. This definition would surely include geology, in particular petroleum geology, among the professions, and the close analogies of the practice of the petroleum geologist with those of well-established professions are conspicuous.**
>
> **For many years the legal and medical professions have each maintained self-established and self-administered standards which determine the eligibility of all applicants for membership. These standards are not only subject to approval by an appropriate agency of government, state or local, but also their rigid maintenance is enforced by law. I believe that this same professional responsibility must be assumed by our own profession as, more and more, it comes to serve the public. If we geologists do not ourselves establish and put into effect standards of professional adequacy, government will set up its own standards. In either case the professional geologist will be required by law to conform to those standards.**

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[19] ***State of Idaho, Act Relating to Professional Geologists, 19th May 1971,*** **Section 54-2819 Code of Ethics.**

[20] **Wallace E. Pratt, "Certification of Professional Geologists, *The American Association of Petroleum Geologists Bulletin*, July 1966, pp. 1501, 02. Reprinted with permission of the AAPG.**

1.26 In "Geophysics in the Affairs of Man" the authors make frequent reference to geophysics as a profession.[21] Chapter 1 of this book is entitled "Some Antecedents to the Modern Day *Profession of Geophysics* Through World War I". Some other examples are: "... the development of the *geophysical profession* during the 1800s was a very slow one and largely academic in nature"; "Because *the profession* was young, the people in it were young." (1920s - 1930s); "Salary levels and job openings *within the profession* are also excellent, particularly on the industrial side." (1970s - 1980s)

Branches of Geology and Geophysics

1.27 For many years, the profession of engineering has been subdivided or classified into several different branches, the more common being mechanical, aeronautical, civil, electrical and chemical. There are many different engineering degree programs, which correspond to the various branches, offered at Canadian and American universities with new programs being introduced at a substantial rate. Similarly, the geological and geophysical professions can also be classified into branches or divisions.

1.28 There are several ways of subdividing the geosciences professions (geology and geophysics), but in reality no clear boundaries exist between the many fields.[22] Generally, most Canadian geologists begin their studies with concentration on igneous and metamorphic rocks if they have a career in mining in mind, or else in the study of sedimentary rocks, which emphasizes the nature of the younger, sedimentary cover (less than 600 million years old), and commonly leads to a career in the oil and gas industry. Most geology or earth science departments in Canada offer a basic background in the two areas; some will concentrate on only one. Programs in geophysics do not fit this pattern.

Geology

1.29 The generally accepted branches of geology are listed as follows along with a brief description of the characteristics or nature of each.

1.29.1 *Petroleum Geology*

Petroleum geology, according to a publication of the American Geological institute, is that branch of geology which relates to the origin, occurrence, migration, accumulation and exploration for hydrocarbon fuels. Its practice involves the application of geochemistry, geophysics, paleontology, structural geology and stratigraphy to the problems of finding hydrocarbons.[23] Thus a petroleum geologist is a geologist who is engaged in the exploration or production processes of hydrocarbon fuels.

It takes a considerable amount of skill and expertise to locate petroleum, and the petroleum geologist must be well versed in stratigraphy, sedimentology, structural geology and geophysical techniques to make interpretations of the geology so that the chance of discovering economic hydrocarbons is increased. The petroleum geologist's work has its descriptive and

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[21] **See footnote 6.**

[22] **See footnote 3.**

[23] **Margaret Garey, Robert McAfee Jr. and Carol L. Wolfe, Editors, *Glossary of Geology*, American Geological Institute, Washington, D.C., 1972.**

interpretive aspects, but the emphasis is on the descriptive because the goal is a deterministic model of the area under study – ultimately, the oil or gas field.[24]

1.29.2 *Mining Geology*[25]

The mining industry in its task of finding, following and extracting metallic ores has always made use of geology in one way or another. Writings on mining since medieval times all venture into discussions of ore genesis and ore localization: naive and amusing as they may seem now, they are the best geology known at the time and were, even then, considered part of the knowledge essential to mining. Until geologists began to take an interest in the specialized problems of mining, each miner or engineer had to be his own geologist, applying as best he could, and often with marked success, the ideas that he gained from science or developed by himself. Only during the last century, and particularly during the last generation, have those aspects of geology that are applicable to mining been developed to such a degree as to form the basis for a separate branch of the profession.

In these days most projects for the exploration and development of metals are carried out under some form of geological guidance, whether it is supplied by professional geologists or by engineers who have themselves acquired a knowledge of geology, and whether it is based on original investigation or on surveys by government or scientific organizations.

Of the professional geologists who devote their attention to matters bearing on mining, many, but by no means all, are employed by mining companies. A large group are in government employ, and a few are engaged by organizations concerned with the financial aspects of mining.

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[24] **R.E. Chapman, *Petroleum Geology*, (Elsevier Science Publishers, 1983), p. 67.**

[25] **Hugh Exton McKinstry, *Mining Geology*, (Prentice-Hall, Incorporated, Inglewood Cliff, New Jersey, 1948) p. xv. Reprinted with permission of the publisher.**

1.29.3 *Engineering Geology*[26]

As defined by the Association of Engineering Geologists, engineering geology is the application of geologic data, techniques and principles to the study of rock and soil surficial materials and groundwater, for the proper location, planning, design, construction, operation and maintenance of engineering structures. Engineering geology is commonly tied in with environmental geology, or hydrogeology.

Like geological engineers, engineering geologists are expected to solve practical engineering problems. They assess the natural foundation conditions for buildings, bridges, dams and reservoirs, power plants, pipelines, highway, canals, sewer, tunnels, mine adits and harbours. Design of these structures requires a thorough knowledge of the mechanical properties and stability of the rocks and sediments that will carry them.

Engineering geologists assess the anticipated impact of subsidence, rains, floods, landslides, volcanoes and earthquakes on these structures. They explore the physical and chemical properties of structural materials (sand, gravel, cement, clay) and water in the vicinity of construction sites. They advise on planning and location of new urban and industrial development in cities, particularly waste disposal sites, and particularly those for the disposal of nuclear wastes. For arctic climates, engineering geologists are focusing increasing attention on permafrost problems.

1.29.4 *Hydrogeology*[27]

Hydrogeology or groundwater geology, as it is sometimes termed, is the study of occurrence, movement and qualitative-quantitative aspects of water, particularly subsurface water. Agricultural, industrial and residential regions require large quantities of pure, uncontaminated water, often beyond that readily available at the surface.

The hydrogeologist's task is to find these hidden subsurface water resources, assess their quality and determine reservoir potential. In addition, the hydrogeologist is often directly involved in major assessment studies, where the problem of water pollution or the problem of chemical or radioactive waste disposal is critical. Many, if not most, hydrogeologists operate as consultants to industry or government.

1.29.5 *Environmental Geology*[27]

Environmental geology is the study of the interaction between the surficial layers (rocks, sediments and soils), the waters in or on them, the atmosphere and the organisms, especially man, that occupy all three. One of the most important components of environmental geology is stratigraphy, with data largely supplied by test drilling, geophysical techniques and geological engineering.

In Alberta, the most important aspect of environmental geology is glacial geology and groundwater (including physical characteristics of the materials).

Environmental geologists are closely involved in teams, commissions or enquiries that analyze the impact on the environment caused by development of underground or surface

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[26] **See footnote 3.**

[27] **See footnote 3.**

mines, by diversion of rivers or lakes, by expansion of urban or industrial areas at the expense of wilderness and agricultural zones and waste disposal. They work alongside hydrogeologists, glacial geologists, engineers, biologists and chemists. They provide geotechnical engineers with the necessary geological framework. Such geologists are in the forefront of decision making when nuclear or chemical waste disposal problems are being resolved. In effect, the environmental geologist is expected to provide information that will buffer or minimize man's contact with nature.

Because environmental geologists deal not only with the surficial deposits, but also with the bedrock underneath, their university background must be solid in the fields of stratigraphy, sedimentology, structures, geomorphology and geological processes and models.

1.29.6 *Marine Geology*

Also known as geological oceanography, marine geology is that aspect of the study of the ocean which deals specifically with the ocean floor and the ocean-continent border. It includes submarine relief features, the geochemistry and petrology of the sediments and rocks of the ocean floor and the influence of sea water and waves on the ocean bottom and its materials.[28]

Geophysics

1.30 Branches of geophysics are less easily defined than those of geology. The more common ones are listed as follows.

1.30.1 *Petroleum Geophysics*

Petroleum geophysics is a true remote sensing process in which an observer near the surface of the ground records the physical response of the subsurface sedimentary rocks to certain applied natural or induced energy, and interprets the recordings for the purpose of locating and defining hydrocarbon deposits. The properties sensed are generally divided into two major classes: potential fields and seismic signals, most commonly reflections, but also refraction. The data acquired is similar onshore and offshore, but logistics dictates substantial differences in operations conducted over land and over water.

Definition of the subsurface falls into two major categories: structural, which seeks to describe the existing shape and tectonic history and, more recently, stratigraphic, which endeavours to determine the nature and depositional history of the sediments.

Raw field data is normally distorted and contaminated by noise and other unwanted signals. Signal enhancement and reduction of field data forms a major intermediate activity.

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[28] See footnote 23.

following which the data are interpreted. Although quantitative measurements are made, the measured response usually represents the sum of a number of components and conditions, leaving considerable room for ambiguity in the interpretation. Therefore, as is the case with geology, professional opinion and judgement are heavily involved, and the results normally benefit from long and varied experience in professional practice.

Petroleum geophysics draws experts from many disciplines, in order to cover the diverse activities required by the industry. These include graduates in the fields of geology, physics, mathematics, electrical engineering and computer science in addition to geophysics.

1.30.2 *Mining Geophysics*[29]

Mining geophysics plays an important role in the exploration for new mineral deposits. This branch of geophysics involves data collection using sensing devices on aircraft or on the ground, and data processing which includes manipulation of the data to draw conclusions about where ore bodies may occur, and preparation of graphs and maps of such data.

Mining geophysics involves the location, through remote sensing of physical properties, of subsurface mineral concentrations i.e. (anomalies) eventually to be proven by diamond drill sampling as either valuable or worthless. Since only one in two hundred to one in five thousand anomalies prove to be ore bodies, it is economically essential for mining geophysicists to select only the most promising anomalies for further investigation. In this process they work in close liaison with a team of other earth science specialists, usually under the supervision of an economic geologist.

In mining geophysics, the nature of subsurface geology can be determined using a range of instruments employing the electromagnetic spectrum from D.C. through 100 megahertz and even to a million, trillion megahertz, if radioactive radiation detection instruments are included. With a gravity meter having a sensitivity of one part in 10^8 thousand, the increase in gravitational attraction over a heavy mineral ore body can be detected.

Data processing in mining geophysics is a relatively new and rapidly developing industry. The introduction of the minicomputer and the microprocessor has enabled geophysical data to be collected in digital form even under the typically difficult survey environment. This increasing availability of digital data has stimulated the use of computers for the compilation and interpretation of data.

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[29] See footnote 9.

The computer enables the mining geophysicist to perform a variety of corrections, enhancements and transformations. Since the interpretation of geophysical data is highly dependent on the visual presentation of information, computer graphics are a key element in the process.

1.30.3 *Seismology*[30]

Seismology is the branch of geophysics which uses the ability of rock layers of different densities and therefore different acoustic velocities to transmit shock waves to determine the nature and structural attitude of rocks deep below the surface. Reflection occurs at the interface between layers. In very practical ways, this is used by the petroleum industry to find oil and gas prospects. Artificial shocks are generated and detected via geophones at several widely separated locations. The data is then computerized to produce a seismic cross-section.

The extreme sensitivity of current seismic techniques has led to seismic stratigraphy, a highly sensitive tool in oil exploration and correlations. Seismologists also interpret the shock waves produced by natural earthquakes of rock units to provide interpretations of deep-seated crustal activity and major movements of plates. Improvements in earthquake prediction come from such studies, especially when tied into satellite imagery and precise measurements of distance using laser-ranging techniques.

1.30.4 *Petrophysics*[30]

Rocks have specific capacities to conduct electricity: having their own natural electrical potential, an induced current can provide data concerning the types of rocks present, their porosity and permeability and the nature of the fluids trapped within the rocks. When this became known in the 1920s a whole new field of geological-geophysical exploration was set up in the oil industry, namely well logging or petrophysics. Geophysicists now routinely test the wells drilled and provide accurate indications of the succession of rocks penetrated by their holes. Many other techniques are used to supplement electric logging: neutron, nuclear magnetic resonance, temperature, gamma-ray logging and others.

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[30] **See footnote 3.**

1.30.5 *Engineering Geophysics*[31]

Engineering geophysics generally involves geophysical investigations in support of large engineering projects, in the planning, construction and operational use stages. Engineering geophysicists may participate in site evaluations for major projects such as hydroelectric reservoirs and nuclear power plants. They may investigate ground conditions in polar regions, for example, to determine the location of permafrost and in earthquake and volcanic-prone areas to determine risk and zoning.

One class of problems in which engineering geophysicists play a significant role is the investigation of existing structures and their foundations. These problems have recently become more significant because of an aging and decaying infrastructure, and the remedial efforts are directed towards increasing the useful life of the structure and ensuring public safety. One example is the examination of earth and rockfill dams to investigate the anomalous seepage through, under or around the dam.[32] Investigations of this nature are also important because structures such as freeways near San Francisco may have been built without adequate appreciation of the risk of earthquakes.

Seismic and electrical geophysical methods are the ones that are used more widely in engineering studies, for they measure elasticity and fluid content properties respectively. While seismic methods are not particularly sensitive to the presence of cracks or fluids, electric methods respond quickly to the ions contained in the fluids that often populate cracks in rock formations. Electromagnetic methods measure the electrical conductivity of rock at frequencies from 0 to many megahertz. Interpretation of the results requires experience and skill on the part of the engineering geophysicist.

Using equipment refined from that of large-scale earthquake seismology, engineering geophysicists measure the degree of seismic activity in an area including small earthquakes to estimate the risk of a large event. Geologic observations may also be integrated with geophysical data to produce a composite risk assessment.

The seismic and ground movement precursors to volcanic eruption are reasonably well understood. Engineering geophysicists monitoring ground movement using effective surveying techniques and seismic activity with good event detecting seismic recorders can often provide a warning of impending volcanic eruption a few days to hours in advance.

Relationships between Geologists and Geophysicists

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[31] Dr. Edo Nyland, P. Geoph., University of Alberta, Unpublished notes, January 1990.

[32] Dwaine K. Butler, Jose L. Llopis and Charles M. Deaver, "Comprehensive Geophysical Investigation of an Existing Dam Foundation", *Geophysics: The leading Edge of Exploration*, August 1989, pp. 10-18.

1.31 Neil J. Smith of Chevron Oil Company, as President of the Society of Exploration Geophysicists (SEG), in 1967 gave a presidential address on this topic. Mr. Smith was a geologist by training and a geophysicist by practice, and thus felt he was qualified to discuss such relationships. Portions of his address are repeated below.[33]

> If one goes back in time for 45 years, the geologist, young, happy, and bright, was beginning to run out of surface structures. About then the torsion-seismic method followed, and then the reflection-seismic method.
>
> The techniques were applied at the onset by physicists, as only a few could claim the 'geo' prefix. These men, trained to find rigorous proofs and record repeatable measurements, did not easily communicate with the geologist. The geologists by training was not interested in the rock parameters which the physicists were measuring. Density differences and formation velocities were intangible. What the geologist thought was 'thinking big', the physicist thought was 'sloppy thinking'. They might not have cooperated at all except that the newcomers, during their first impacts, made finding oil like 'shooting fish in a barrel'.
>
> Here were interlopers, the physicists, making changes, a natural basis for resentment - just as the Indian resented the white man, the cattleman resented the sheepman, and the Californian resented the Okie. However natural this attitude may be, it does not appear to be effective: the interlopers stay; the changes go on. Remember the case of the Indian!
>
> Resistance and resentment were not universal. Geologists not frightened by mathematics and physics *and* physicists, or the electrical engineers who could appreciate the nature of geology, worked together readily. After a while they, mutually, began to be geophysicists. That was how the trouble began and how it began to disappear. If one looks squarely at the problems remaining, they are few. The peripheral squeaks and groans are from ghosts, or from those who like friction for the warmth it gives.
>
> It would be strange if relations were not good by 1967. There is a great deal of interpenetration between the disciplines. Most companies give their geologists training in geophysics, commonly for extensive periods. On the geophysical side, more than a third of the SEG members are geologists by training. Another large fraction are either geologically oriented or are eager to be. The remainder can hardly be a source of friction, as they are largely specialists who have no need to 'interface' with the geologists to any extent.
>
> However, I would not want to disappoint anyone by claiming no areas of friction. There are two which persist to measurable degrees. A geologist who works with geophysical data and who can manipulate them and use them properly is accepted by geophysicists as a geophysicist. It is like swimming. If a man dives into the water and swims, he is a swimmer. He is the kind of swimmer his performance shows him to be. So it is with the geologists working in geophysics.
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> The converse does not hold true, at least not for the geophysicist whose degree is not geological.

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[33] Neil J. Smith, "Relationships between Geologists and Geophysicists:, *The American Association of Petroleum Geologists Bulletin*, November 1967, pp. 2189 - 2191. Reprinted with permission of the AAPG.

He is viewed with consternation if he is observed swimming from point to point in the geological pool. He is narrowly observed for signs of water wings or other evidence of cheating. He is watched for deviations from local geologic fetishes. Evidence notwithstanding, he had better be wary of suggesting a down-to-the-north fault where the established thought is down-to-the-south. The attempt itself is impudence; should it prove to be correct, the credit will go to 'luck'.

However, what cannot be gained by experience and demonstration can be won by academic retreading. If he has a geology degree in hand, from night school or wherever, all is well.

This attitude is not without a basis in reason. The geophysicist tends to be broad-minded in his acceptances as is understandable in a man whose education is heterogeneous. Further, it is relatively easy to examine a man's competence in geophysical techniques, whereas geological assertions may be difficult to evaluate. Geology is somewhat like psychiatry where schools may differ so widely on important theories that a practitioner must show his diploma to be entitled to an opinion. As a geologist, I can appreciate the position; as a geophysicist, I do not like it.

There is another persistent area of minor contention. Both the geologist and the geophysicist seem to believe that the other has the 'best deal', the most appreciation, the surest road to advancement. I have not been able to find any consistent basis for this in either profession.

This belief may relate to the observation that, when management has a group of professionals from which to draw in order to fill a supervisory position, it seems to have trouble giving the more specialized man a chance. The less specialized man may not be able to fill the specialist's shoes. Then, more moves have to be made with attendant confusion and substantial cost. As can be seen, this is really the specialist's dilemma. The apparent bias exists only to the extent that geophysics contains a higher percentage of specialists than geology.

It would ease management's burden and conscience and resolve the specialist's dilemma in large part if management could promote a professional ladder which would meet professional and community-reward standards. This is easier said than done because neither the professional nor the community has developed mutually acceptable patterns of recognition; development seems to be underway and, perhaps, can be accelerated.

So much for these persistent but not devastating problems. We share another more serious. It is a common problem that relates to the rate of technical advance and to rates of absorption of technology. We have our own technical explosion. It has the geophysicist running very hard, trying to keep up and 'get out the wash', too. Forgive him if he seems preoccupied. He is going to intra-company schools, computer schools, seminars developed through local initiative or by professional societies and extension courses set up by universities.

Geologists, of course, share this disturbance. In the past an exploration geophysicist could keep reasonable abreast of the advances in geophysics with reasonable effort. Now a reasonable effort will not do; a most unreasonable effort is required. Because a geologist's job demands an appreciation of what the new techniques can do, and because a geologists must assimilate large amounts of geophysical data relating to the subsurface, he has no choice; he will have to 'put out' the unreasonable effort.

Geologists will have to hurry with this 'little' task, because geology is being digitized. Before long, 'deconvolution' will be a geologic term. Geophysicists are extremely interested in seeing how geologists accept it. The way to do all this is straightforward. It simply requires time, money and hard work. For the individual geologist or geophysicists it means less TV and golf, shorter

> weekends and more homework. For the company, it means organizational flexibility, the breaking of rigid patterns of procedure and the elimination of 'piddle work' or anything done just because it has been done.

1.32 Mr. Smith's article concludes by urging the AAPG and SEG to continue to cooperate so that geologists and geophysicists may keep up with progress in each other's fields. His final remarks are "... one must remember that, though our goals are the same, our roles are not, they are overlapping. We do not want to be so thoroughly integrated that we lose our identities."

Chapter 2
History of Geology and Geophysics Legislation in Alberta

The Beginnings

2.1 The Association known as APEGGA originated in 1920 when the "Engineering Profession Act" was passed by the Alberta Government. It had become evident (not only in Alberta, but in other Canadian provinces and in the U.S.A.) that there was a need to protect the public against deficient engineering practices. Members of the Association were known as "Registered Professional Engineers" or R.P.E.s, and were generally represented on the governing body (Council) under the four branches of engineering - civil, electrical, mechanical and mining.[34]

2.2 An active member of the Association from its inception was Dr. John A. Allan, professor of geology at the University of Alberta since 1912. Dr. Allan, a prominent geologist, joined the Association in 1920 as a Registered Professional Engineer in the mining branch. Besides becoming noted for establishing the Department of Geology at the University and developing the department until his death in 1955, he was very active in the Association during its formative years. He served on Council and became President in 1930. Much of the groundwork for bringing geologists into the Association was due to Dr. Allan.

2.3 Over the next ten years, development of the Association in terms of activities and accomplishments was progressive, both for itself and the public. Although it was not until after the Second World War that positive steps were taken respecting inclusion of the professions of geology and geophysics in the Alberta Act, there are indications of interest and concern as early as 1923. In that year there arose the problem of the right and propriety of a geologist to have the privilege to revise a report he furnished to a mining company, if his subsequent prospecting revealed additional data which could cause him to change his opinion of the ultimate value of the mining property. (The Council decided that the Public Utilities Commission, which controlled stock selling, had the power to preclude possible injustice that might arise in these situations.) The following year, the Association engaged in a publicity campaign to warn the public with respect to reports issued by oil promoters not certified by members (R.P.E.s). The experience of several investors in the Turner Valley oil fields justified this action.

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[34] *History of the Association of Professional Engineers of Alberta*, APEA Publication, 1947.

Interest in Geology and Geophysics

2.4 In the late 1920s the discovery of oil in Alberta raised some issues pertinent to the practice of geology. One concerned the matter of differentiating between a mining engineer and a geologist. Both would be registered in the mining branch, but the view was expressed that they were widely separate professions. In 1927 Council decided to adhere to the four basic classifications then existing (civil, electrical, mechanical and mining), but could designate specific subdivisions of each class, and in the case of a member whose exclusive practice was in a particular subdivision in his class, the Council was given power to include this speciality on his certificate and seal.[35] For geologists, the speciality would be "geology". Another issue related to an influx of geologists connected with oil drilling operations in the province. A sufficient number joined the Association to give them representation on the Council under the mining branch.

2.5 The definition of "Professional Engineering" in the Act published in 1922 included (in Schedule A) the words "Investigations relating to the examination, exploration and development of rocks and minerals, mineral deposits, rock structure and the application of geology to the industries of arts, or to engineering". In the amendments of 1942, this had been changed to read: "Geological and other *scientific investigations* relating to the examination, exploration and development of rocks and minerals, mineral deposits, rock structures and their application to industry". This amendment suggests the beginnings of relevance to geophysics.

2.6 In 1941 increased activities by oil companies in seismic and gravimetric exploration work led to four companies making representations to Council in connection with licensing of foreign engineers brought into Alberta. Council decided that party chiefs in seismic, gravimetric and other similar types of work be required to take out licenses.

2.7 Under the "Engineering Profession Act, 1930" and the revised Act of 1943, it was possible for geologists and geophysicists to be registered as members of the Association, provided they satisfied certain requirements and had certain qualifications. They were however designated as "professional engineers".

Geologists Included in Engineering Profession Act

[35] Minutes of Meeting of APEA Council, 1927.

2.8 The matter of separate identification of geologists in the Association began receiving consideration in 1953 as a result of representations from geologists who wanted separate representation on Council and who stated that many of them were unhappy with the designation of Professional Engineer.[36] Council took steps to ensure a geologist member was formally represented on Council.

2.9 In June 1954 the question of relationships between geologists and the provisions of the Engineering Profession Act began receiving considerable attention.[37] There was a "large gap between the professional geologist, working in pure geology, and the engineer, and many geologists were loathe to call themselves 'engineers'". At that time the Alberta Society of Petroleum Geologists (ASPG) had a membership of approximately 700, many of whom were not aware of the facilities available to them under the Engineering Profession Act. Membership of geologists in APEA was only 195, however. (There were an estimated 1,000 geologists in the province.) A separate professional act for geologists appeared an unlikely and difficult prospect, and the Council encouraged continued cooperation and liaison with the ASPG including having more geologists join the Association. A committee was established and met with ASPG including on it J. S. Irwin, P. Eng., a prominent consulting geologist and Past President of the Association, and Dr. H. H. Beach, P. Eng., Chief Geologist of Texaco Exploration Company and member of Council. At the meeting more members were encouraged to join APEA, and it was pointed out that geologists were included in the Engineering Profession Act *at their own request* some years ago. Efforts were directed towards regulation of the practice of geology as well as engineering, and in 1955 a revised Act (although it was still entitled "The Engineering Profession Act, 1955") was introduced as an "Act to regulate the Professions of Engineering and Geology". In this Act a new definition of "professional engineering" or the "practice of professional engineering" included references to discovery, development and utilization of natural resources of materials and energy, and to application of the principles of geology. The academic qualifications for membership now included graduation from the University of Alberta in geology as well as engineering, or from a university approved by the General Faculty Council with respect to its program in geology.

2.10 The new Act also provided for twelve members of Council compared to the former eight, and Council named two additional geologists as representatives. One of these was Dr. J. C. Sproule, a consulting geologist who was elected President in 1957.

New Act - Formal Regulation of Geology and Geophysics Professions

2.11 By 1956 it was evident that geologists and geophysicists continued to be displeased with the terminology of "Professional Engineer" being applied to them. In March 1956 the Board of Examiners, who had been licensing geophysicists (as engineers), questioned

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[36] Minutes of Meeting of Council, September 1953.

[37] Minutes of Meeting of Council, June 1954.

whether they should have a separate syllabus for examinations.[38] The Association's Act and Bylaws Committee was authorized to study the classification of professional scientific fields within one Act, with priority to the situation regarding geologists and geophysicists and the use of separate designations. Representations were received from the chemists and foresters for inclusion in the Act, but in the course of deliberations by the Committee and development of amendments to the Act, only the designations for geologists and geophysicists were considered.

2.12 The proposed revisions were discussed at the 1959 Annual Meeting, and reviewed again over the next year. The report of Dr. G. W. Govier, P. Eng., Chairman of the Act and Bylaws Committee contains the following statement:[39]

> The Executive of the Association has recently had several very satisfactory discussions with groups representing the Alberta Society of Petroleum Geologists and the Canadian Society of Exploration Geophysicists. The most recent of these discussions occurred on March 2nd when the Association Executive had the pleasure of meeting with a Special Committee on legislation formed of representatives from both of the above Societies. I have subsequently been assured that the representatives on that committee have reported back to their Societies indicating support for the Association in the matter of revisions to the Act. There is now absolutely no opposition from these groups.

The revised Act - an "Act to regulate the professions of Engineering, Geology and Geophysics" was assented to in March 1960. Its title was changed to "The Engineering and Related Professions Act".

2.13 The major additions and changes to the Act, resulting from the wish to include geologists and geophysicists under separate designations, were as follows:

- The inclusion of definitions for professional geologist and professional geophysicist and the practice of these professions.
- Representation on Council to consist of a minimum of two professional geologists and one professional geophysicist.
- Introduction of professional affairs committees to represent each of these professions and advise Council thereon.

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[38] Minutes of Meeting of Council, March 1956.

[39] Minutes of 40th Annual General Meeting, APEA, March 16th, 1960.

- Inclusion of approved geophysics programs in the academic qualifications required for registration (geology programs had been introduced in the 1955 Act).

- Use of the abbreviations, for the first time, of P. Eng., P. Geol. and P. Geoph.

The name of the Association remained as APEA, and because of the difficulty in getting agreement among the membership, it was not changed to APEGGA until a number of years later.

2.14 At that time (1960), there were approximately 300 geologists and 150 geophysicists in the Association out of a total of some 3,000 members. A proposal to change the name of the Association to reflect geophysicists and geologists as well as engineers received considerable discussion at the 1960 Annual Meeting, but action was deferred to a later date. There was also concern that the new Act would require geologists to join the Association, but the ASPG were informed that Council's policy regarding enforcement would remain unchanged i.e. that registration of employees would be encouraged but not insisted upon. In response, the ASPG stated that it *recognized that future Association managements would not necessarily be committed to retaining the moderate degree of enforcement.* Similar concern was expressed by the Canadian Society of Exploration Geophysicists (CSEG); (both the ASPG and CSEG had set up committees to study the revised Act). The concept of "total registration" was not endorsed, but the CSEG, in accepting Council's policy of moderate enforcement, also recognized that the attitude of future Councils might change.

Reclassification to P. Geol. and P. Geoph.

2.15 Following passage of the new Act, steps were taken to have geologist and geophysicist members of the Association reclassified from professional engineer to professional geologist and professional geophysicist. Records of all members were accordingly reviewed by the Board of Examiners to determine, on the basis of original registration by qualifications in geology or geophysics, those that should have their designation changed. Letters were sent to all members informing them of the Board's policy:

1. Those registered on the basis of both educational and experience qualifications in geology (but not geological engineering) would be immediately reclassified as P. Geol.

2. Those registered on the basis of both educational and experience qualifications in geophysics would be immediately reclassified as P. Geoph.

3. All others would remain classified as P. Eng.

4. The above was subject to appeal by the member. Some members, for example,

may not have been fully qualified, but had qualifications close to P. Geol. or P. Geoph. yet were not reclassified.

2.16 Some members were concerned that on reclassification they would not be permitted to do work of a professional engineering nature. This prompted Council to issue a statement affirming that past policy would not change i.e. that a reclassified member could continue to practice in his original fields provided he was qualified in the fields concerned as required by the Code of Ethics.

Reaction of Geological and Geophysical Community

2.17 The professions of geology and geophysics can be considered to have been legally recognized in Alberta in 1955 and in 1960 respectively. Although at that time (1960) the two societies ASPG and CSEG supported such legal recognition, there continued over the next 20 years an undercurrent of opposition among segments of their membership to such recognition and to registration in APEGGA. Some registered geologists and geophysicists were also dissatisfied, although the majority were strong supporters of legislation, under a single Act, which included regulation of the practice of geology and geophysics as well as engineering. Some of the reasons behind the opposition were:

- Protection of the public was viewed as being less of a basis for regulating geology and geophysics practice than engineering practice.
- The academic requirements for registration were viewed as being unnecessarily restrictive.
- Geophysicists and geologists employed in industry (large oil companies for example) saw little need for formal registration.
- The aspirations of geologists and geophysicists in the professional as well as the technical sense would be met adequately by the ASPG and CSEG.

2.18 In 1959-61 the APEGGA Public Relations Committee was actively involved in discussions with the ASPG and CSEG with the aim of enhancing liaison and cooperation with these two groups. The committee endeavoured to explain the role of the Association with a view to encouraging registration. These kinds of activities and discussions continued over the next 20 years.

2.19 In October 1980 the concerns of many geologists and geophysicists were publicly expressed at a joint meeting of the Canadian Society of Petroleum Geologists (ASPG had changed its name to CSPG in 1973) and CSEG held in Calgary. At that meeting, approximately 800 geologists and geophysicists heard members of a panel speak for and against registration under APEGGA. From the ensuing discussion, a number of alternatives

emerged, and an eight-man committee composed of professional geologist and professional geophysicist members of APEGGA, with Dr. Gordon D. Williams, P. Geol. as chairman, was formed to examine these alternatives. The committee's report of 1982[40] recommended several actions to correct the problems and alleviate the concerns, including that the CSPG and CSEG establish a standing committee to work with APEGGA on these matters on a continuing basis. It also recommended that the situation be reevaluated in three years' time by the standing committee with the objective of recommending one of two courses of action:

1. Continue the legislation with APEGGA under a common Act of the legislature.

2. Lobby the Provincial Government to establish an Earth Sciences Act for the professions of geology and geophysics to be administered by an independent earth sciences association.

The standing committee was established in 1983 (see paragraph 2.23). However, during the process of introducing the revised Act in 1981, it became clear that government would not entertain a proposal for a separate act, and the second course of action was not pursued.

1981 - Revised Legislation Introduced

2.20 At about the time the above committee was active, a new Engineering, Geological and Geophysical Professions Act was being prepared. A revised Act had been presented to Government by APEGGA in 1975, but deferred in light of the 1978 Government paper "Policy Governing Future legislation for the Professions and Occupations". During preparation APEGGA was required to justify continued legislation governing the professions of geology and geophysics, with the probable alternative of having no legislation at all for these two professions. The new Act was proclaimed in July 1981 and included, among other items, specific clauses on scope of practice and use of the titles respecting geology and geophysics (as well as engineering). A Practice Review Board, with powers similar to those of the Discipline Committee, was introduced. This Board included in its membership a professional geologist and a professional geophysicist.

2.21 At about the time the new Act was being drafted, it was evident that the Association's enforcement activities over the past few years had deteriorated and the number of discipline cases was increasing. Council therefore established a task force to study these matters in depth. The task force, chaired by Dr. Cal R. Evans, P. Geol., made a number of recommendations about APEGGA establishing definitive policies regarding enforcement of the Act and upscaling enforcement activities generally. Formation of a second task force to deal specifically with enforcement was recommended and put into effect by Council. Based on the report and recommendations of this second task force, chaired by Duncan A. Carswell, P. Geoph., Council decided that the Association would implement an active enforcement

[40] ***Final Report of Committee on Professional Registration***, May 1982

program having the same level of importance as registration and discipline.[41] Reasons for this decision were:

1. The public can have confidence in the expertise and ethics of members when the title and practice provisions of the Act are enforced.

2. One of the reasons the Association was established and given certain responsibilities was to enforce these provisions.

3. Registration and discipline are only partially effective if enforcement is not actively carried out.

2.21 The revised Act introduced in 1981 contained more definitive provisions on scope of practice of the three professions and use of the title engineer, geologist and geophysicist. It should also be noted that more active enforcement was one of the recommendations of the Williams' committee on professional registration (of geologists and geophysicists).[42]

Geology and Geophysics Liaison Committee Established

2.23 The recommendation of the Williams' committee that a joint committee be established was adopted in early 1983. Following a series of restructurings, it was designated as the CSEG/CSPG/APEGGA Liaison Committee.

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[41] Minutes of Meeting of APEGGA Council, November 1980.

[42] See footnote 40.

2.24 The Liaison Committee held a series of meetings over the 1983-86 time period. Several issues of significance and concern to geologists and geophysicists were brought forward and acted upon:[43]

- Registration of geologists - the CSPG proposed a Canada-wide accreditation system as a standard for measuring academic requirements for registration, similar to the system for engineers. The proposal was generating attention and discussion by the Canadian Geoscience Council and other organizations. (See Chapter 6)

- Registration of geophysicists in Alberta - the academic requirements for registration were perceived as being unduly narrow. This issue evolved into development of a revised geophysics syllabus of examinations which was drafted by a specific subcommittee of the Liaison Committee. (See Chapter 4)

- Scope of the practices of geology and geophysics and exemptions from these practices by certain persons needed better definition. Amendments to legislation were at that time being prepared, and further revisions proposed by CSEG and CSPG were included.

- Enforcement - the active enforcement program that was being implemented following the Carswell report (paragraph 2.21 above) was considered to be unnecessarily severe against individuals and companies reported to be engaged in the practice of geology and geophysics. This concern led to a modification of enforcement procedures against such individuals and companies. Several potential enforcement cases were placed on hold by APEGGA while these procedural modifications were being developed.

2.25 The CSEG/CSPG/APEGGA Liaison Committee has proven an effective mechanism for dealing with the concerns of professional geologists and geophysicists within APEGGA. It remains in being as a viable entity with its major objective being: " To review, with APEGGA, issues of concern relating to the practices of geology and geophysics as regulated by, and administered under, the Engineering, Geological and Geophysical Professions Act, and to strive for the resolution of such issues for the general improvement in the standing of these professions within APEGGA." Complete terms of reference are contained in Appendix A.

[43] Minutes of Liaison Committee Meetings 1983 - 86.

Chapter 3
Reasons for Regulation of These Professions

The Practice of Geophysics

3.1 Several years ago Dr. Roy O. Lindseth, P. Geoph. wrote an article on the registration of geophysicists. The text of his article is reproduced below, updated to 1989 by Dr. Lindseth.

3.2 The merits of professional registration of geophysicists is a question which has long been argued. The major point in the case against registration arises from the fact that some 96% of all geophysicists engaged in commercial, rather than scientific, activities practice petroleum exploration. Most of them are employed by oil companies or operate under retainer to oil companies. They normally report directly to senior explorationists who have a good working knowledge of geophysical exploration. Their work is very frequently subject to peer evaluation. Furthermore, a geophysical study is often only one component of several elements entering into an exploration decision and, as such, does not carry the full responsibility for the exploration decision. For these reasons those exposed to registration correctly consider that most geophysical work does not impinge directly upon the public and the public, therefore, is not at risk.

3.3 These arguments so far appear to have been widely accepted with telling effect: outside Alberta the only other jurisdiction with an active professional registration program governing a substantial body of geophysicists is the State of California. Other jurisdictions in Canada, however, are now registering geophysicists and still others are giving serious consideration to their registration. (see paragraphs 3.25 - 3.32)

3.4 Geophysicists are an independent group, and when registration has been proposed they most often argue against it. This was the case in California, where a strong and vociferous lobby was mounted against the law when it was first proposed in the early 1970s. However, after hearing all arguments, the bill was passed by the state legislature in 1973. California also has a Sunset law, under which all such legislation is reviewed periodically to verify its need. In 1978, following a Sunset review, it was decided to continue registration of geophysicists in California.

3.5 The experience of the State of California is cited because, like Western Canada, it is a mature petroleum exploration area with a large number of resident geophysicists. Some of the following arguments in favour of registration therefore have greater significance.

3.6 The fundamental argument in favour of registration of geophysicists is protection of the public. In a mature area, large numbers of small exploration organizations develop, often consisting primarily of speculators and inventors working independently of conventional operating oil companies. Under tax laws which exist from time to time in Canada and the U.S., investments in petroleum exploration can be sheltered from taxation. These shelters attract a large number of unsophisticated investors into such group investment vehicles as drilling funds and limited partnerships. The promoter groups may do primary exploration and often work on farmouts (usually an area controlled by a large oil company in which the

quality of a given play is less than the minimum acceptable standard for that company. In return for some consideration, the owner will farm out the acreage to any group willing to accept the risk). In most of these operations, there is a strong incentive to make the play appear as attractive as possible to the investor. The primary exploration tool for petroleum plays is the reflection seismograph. Therefore substantial emphasis may be placed upon geophysical opinion and considerable pressure may be exerted to produce a favourable report. This may come from an independent professional consulting geophysicist, or may be the opinion of a geophysicist employed by either the company promoting or farming out the play.

3.7 In such cases, the public should be protected from unwarranted economic exposure as well as any physical harm. Therefore, a telling argument for the registration of geophysicists is to protect the public from unwarranted optimistic opinions in some of the situations outlined.

3.8 The second major argument for professional registration of geophysicists is more administrative in nature, relating to the much stronger case that can be made for registration of geologists. A fairly large proportion of the geological profession is engaged in activities which deal directly with the public, not only in the petroleum industry but in a wide range of activities related to minerals, groundwater and construction. In the petroleum industry, a geologist is often the prime mover in development, marketing and execution of exploration plays and also in the drilling of the actual well. His opinions may affect activities which have a direct bearing on public health and safety in addition to financial risk. Most geologists support and encourage some form of professional registration.

3.9 Geological and geophysical activities overlap to a substantial degree, the main difference being that the geologist deals with direct measurement of the rocks while the geophysicists interprets such information from measurements of the response of the rock to some form of excitation. Except for this fundamental difference in source data, the professional activities of the two often tend to overlap substantially, yet each professional recognizes the other as a distinct discipline having several different educational and experience requirements. Unfortunately, it is almost impossible to draft any law for professional registration of geologists which excludes geophysical activities. If the law is sufficiently broad to encompass normal geological activities, it invariably includes much of that which is defined as geophysics and geophysicists would find it impossible to practice without registration as geologists, which they agree they are not. Conversely, if a satisfactory law is drafted to exclude geophysicists, it ends up with very large loopholes, rendering it ineffective for geologists. This may be one reason that the Alberta Government is not receptive to separate legislation for each of these two professions.

3.10 The true value in legislation for professional registration lies in the sections covering enforcement and discipline. Where legal registration does not exist, geologists and geophysicists invariably form voluntary groups which adhere to most of the rules for professional practice and a code of ethics. They will also include procedures for enforcement and discipline but, unfortunately, the penalties, such as expulsion from the voluntary

association, are totally ineffective and have never proven to be an effective deterrent to unprofessional practice.

3.11 The overwhelming majority of geophysicists are conscientious professionals who conduct their practice with the same responsible attitudes whether legislation exists or not. Legislation is needed to protect the public and the profession from the unprincipled acts of the charlatan or the morally deficient individual who uses the shelter of the excellent reputation earned by the profession to violate the confidence and trust of an unsophisticated investor. (End of article)

3.12 Also germane to regulation of the practice of geophysics is the report to Council in 1960 of a small committee of members of the Association which examined the draft act being developed at that time.[44] This committee listed several points in support of including geophysicists in the Alberta Act. It considered the objectives of the professional association to be twofold: to protect the public and to protect the profession. Both objectives are concerned with control of the ethics of the people who are performing professional services. An association embracing geophysicists, then, should afford a means whereby the geophysicists' qualifications may be reviewed and an official registration provided acknowledging acceptance of those qualifications; the Association should also provide suitable disciplinary procedures.

3.13 The committee listed some situations in which geophysicists may be considered as having dealings with the public - situations in which protection of the public might be of concern. These situations are valid today and are similar to the comments made by Dr. Lindseth:

1. Geophysical consultants advertise their services publicly and may be considered as having public contacts; this group should have registration in an association both for protection of the public and for their own protection. Geophysical contractors also do a small amount of work that can be considered as consulting; key personnel should be registered for these purposes.

2. Geophysical work often leads to reports, parts or all of which must be transmitted to government agencies in compliance with government regulations. The Alberta Department of Energy and Natural Resources recognizes a need for licensing of geophysicists. For example, in accordance with the Alberta Geophysical Incentive Regulations, a final report on a geophysical incentive program is required to be made on behalf of the licensee (holder of an exploration license under which a seismic reflection program is conducted) by a registered professional geophysicist (or geologist or

[44] Special Committee of Council. *Report on the Engineering Profession Act*. February 1960.

engineer).[45] In another example, the Exploratory Drilling Incentive Regulation requires a report to the Minister of Energy and Natural Resources covering expenditures on incentive exploratory wells signed and sealed by a professional geophysicist (or geologist or engineer) for credit to be determined and granted.[46]

3. Geophysical reports may be used in full or out of context for the purposes of promoting stocks and securities. This is a public matter and such reports should only appear over the name of a registered professional geophysicist. (A geophysicist who might be inclined to sign a false or misleading report for purposes of stock manipulation might be less inclined to do so if he ran the risk of losing his license.)

4. A geophysicist may appear in court or before some hearing or commission to present testimony as an expert. This is a public matter and it is appropriate in such instances that a geophysicist so appearing should be qualified through registration.

3.14 Dr. Lindseth lists two additional reasons for regulation of geophysics practice:

1. A small exploration company that does not have its own geophysical staff has a right to expect work of professional calibre from professional geophysical consultants or contractors that it might employ from time to time. The term "P. Geoph." gives some assurance of professionalism.

2. In certain branches of geophysics, such as high-resolution surveys for dam sites, marine drilling locations and pipeline right-of-ways, misinterpreted seismic data could certainly pose a potential hazard to the public.

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3.15 Most of the reasons cited in the foregoing paragraphs for registration of geophysicists

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[45] Geophysical Incentive Regulation 1984, Alberta Regulation 138/84.

[46] Exploratory Drilling Incentive Regulation 1984, Alberta Regulation 137/84.

[47] Gordon D Williams, P. Geol., Phillip L. Hall, P. Geol., unpublished notes.

also apply to the practice of geology. However, geological practice has more of a direct impact on the public than geophysical practice (see paragraph 3.8).

3.16 It is appropriate that geologists be registered for a number of reasons. The most important of these is protection of the public from the activities of unqualified, incompetent or unscrupulous individuals. Whereas in the practice of engineering the potential danger to the public may involve loss of life, limb or property, in the practice of geology, which primarily involves resource evaluation and development, the largest potential danger is financial. Decisions and recommendations made by geologists with respect to assessment of mineral and petroleum resources, even by those in employee positions with companies, often involve the expenditure of extremely large sums of money, in many instances by investors who have little or no qualification to evaluate the technical soundness of geological advice they may receive. This is particularly true in the petroleum industry in Alberta at times when most of the exploratory drilling is being financed by drilling funds, private investment syndicates and corporations whose experience, knowledge and expertise lie in other areas. It is also equally true in the minerals industry. Where shares of resource-based corporations are offered to the public, a technical appraisal of the properties of the corporation must be made to satisfy the requirements of the appropriate securities commissions and thereby to offer some protection to potential investors. This can be done most effectively by qualified, experienced and responsible geologists, and registration in a professional association ensures the acceptability of academic and experience qualifications of such geological practitioners.

3.17 Protection of the public involves geological input in such areas as mines design and operation; soils and foundation studies for construction of buildings, bridges, dams and reservoirs; groundwater resource evaluation for municipalities and industries; groundwater pollution resulting from waste disposal including landfill and disposal of radioactive wastes; urban land use studies and assessment of earthquake hazards. Geologists are frequently involved in these areas, either individually or as members of multidisciplinary teams. Unlike engineering practice, there may not be an immediate loss of life resulting from negligence or substandard practice, such as in the collapse of a building, but loss of life could occur from foundation failure or slope failure. Serious long-term environmental impact could result from groundwater contamination. Thus in these areas the activities of unqualified geological practitioners pose a potential danger to much the same extent as do the activities of unqualified engineering practitioners.

3.18 Another reason for registration is that the registering professional association provides a means whereby members of the public who feel they have been the subject of incompetent or unethical practice can seek redress. Technical societies cannot fulfil this role inasmuch as they have no effective means of applying sanctions against an offender. The knowledge that the right to practice is subject to scrutiny by peers and ultimately to withdrawal for improper conduct is a strong incentive for an individual to practice in a responsible professional manner.

3.19 Still another reason for registration involves the positive effect that the presence of a professional association has on the educational standards of institutions which prepare

students for entry into the profession. Changes have been made to the geology curricula at both the University of Alberta and the University of Calgary in response to academic standards required by APEGGA. Practising professionals outside the academic institutions are well qualified to comment on the educational level necessary to practice effectively.

3.20 The practice of geology has become increasingly more diverse and, like the practice of engineering, the number of branches, subdivisions and sub-disciplines is increasing. Regulation of the profession means the application of uniform standards of entrance to the profession and the prevention of unqualified people from practising as geologists. The public needs protection from unscrupulous and unsafe practices and if the profession itself is not prepared to provide this protection, it is likely to be provided by a government agency. In the public interest it is preferable to have the regulation of the practice of geology carried out by a self-governing profession.

Should there be Separate Legislation?

3.21 Accepting that regulation of the practice of geology and geophysics in Alberta as a "fait accompli" and necessary for the reasons described previously, a subject that has caused considerable discussion and argument over many years is whether geologists and geophysicists should be included in the present legislation along with engineers, or whether separate and individual legislation should be established for the two professions. This matter was first considered as early as 1954 when the geologists wished to have professional recognition. At that time it was considered (by Council) that professional recognition of the practice of geology would be best pursued through the Engineering Profession Act as it would likely be difficult to develop a separate professional act.[48]

3.22 One of the criteria accepted by the Government of Alberta for determining the eligibility for recognition under legislation of a profession to be granted autonomous rights or authorities is "Evidence that the services to be provided by members of the Association are not merely fragmentations or duplications of more comprehensive service programs of associations already recognized."[49] The Government paper of 1978 states that "Self-government is a privilege delegated to a profession or occupational group by the legislature only when it is clear the public can best be served by delegating this authority" and "whether or not groups consider themselves professionals is not, of itself, a valid criteria for the determination of whether groups should be self-regulated and to what extent."[50] From the government point of view, it seems that individual acts legislating the practices of geology and geophysics is an unlikely prospect.

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[48] See footnote 36.

[49] See footnote 14.

[50] Government of Alberta, *Policy Governing Future Legislation for the Professions and Occupations*, 1978.

3.23 Apart from governmental considerations, there are other reasons why the professions of geology and geophysics, along with engineering, should continue to be recognized under a single Act. If separate recognition were to be seriously considered, the Canadian societies of petroleum geologists and exploration geophysicists CSPG and CSEG would likely be the bodies that would form the nuclei of the new professional associations. In response to the question "If professional registration is necessary, can CSPG provide this more efficiently than APEGGA?", Dr. Cal R. Evans, P. Geol. states: "Having seen at first hand the amount of work involved in accreditation, registration, enforcement and discipline, I personally feel that it would be a very major mistake for CSPG to try to undertake these activities. In the first place, it would require a number of fulltime staff members so that I doubt that there would be much, if any, cost savings vis-a-vis the service provided by APEGGA. Secondly, and much more seriously, I feel that undertaking this major program would seriously dilute the management efforts of CSPG's executive and thus detract from the very excellent scientific program that the Society has achieved over the past years."[51] Jack M. Browning, P. Geol., APEGGA President 1983-84, makes a similar comment: "The scientific thrust of the CSPG will deteriorate rapidly, the dues will increase rapidly, and the CSPG within a period of 5 years will by run by the professional executive director and his staff. To think otherwise is to underestimate the amount of work required by a professional association."[52] Similar comments could be made respecting the CSEG. Since the number of professional geophysicists is much less than the number of professional geologists, the cost of admission and membership fees levied by a separate professional geophysical licensing association might well be higher than those of a geological registration body.

3.24 The final report of the Williams' Committee on Professional Registration drew the following conclusions with respect to the matter of a separate Act governing the practice of geology and geophysics:[53]

1. Geologists and geophysicists must recognize and accept the practical reality that the practice of their professions in Alberta is governed in law by the Engineering, Geological and Geophysical Professions Act (1981). The Act exists and we must operate within its constraints. In view of Government policy it is very unlikely to be changed by the Provincial Government, certainly not over the next few years, regardless of any submission that might be made.

2. Annual fees payable to an independent association charged with registration of geologists and geophysicists would be comparable to fees currently charged by APEGGA and could well be higher, depending upon the expectation of members. It is anticipated that startup costs associated with lobbying for and drawing up of an act would be in the order of $50,000 spread over a five to eight year period, in addition to regular annual dues.

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[51] Dr. Calvin R. Evans, P. Geol., "Professionalism: Whether Geologists and Geophysicists?" *The Mini-PEGG*, January 1981.

[52] Jack M. Browning, P. Geol., "Pride in Being a Professional Geologist?", *The Mini-PEGG*, November 1981

[53] See footnote 40.

3. Because of the legal and financial conclusions reached above, and the strong impression that at least in part, the straw vote at the October 1980 meeting in favour of registration by CSPG and CSEG was caused by confusion about the roles of technical and professional societies, the Committee concluded that it could not directly follow the wishes of the October 1980 meeting by recommending that the CSPG and CSEG undertake responsibility for professional registration of geologists and geophysicists.

4. Furthermore, although the majority of geologists and geophysicists in Alberta are involved in the petroleum industry as employees, and most of these are located in Calgary, a significant number (10-15%) practice in other areas (mining, geotechnical, coal, environmental, Pleistocene, teaching, government surveys), in other parts of the province and/or are self-employed, and their needs must be considered. It would be inappropriate for the CSPG or CSEG to claim to represent the diverse needs of these earth scientists, and the establishment of a new association separate from APEGGA could create problems of overlapping practice of individuals and companies (geology/engineering, geophysics/engineering) and inevitably, difficulties of the kind which caused problems between engineers and architects.

5. There would not necessarily be any savings in annual membership dues in an association with paid staff, independent of APEGGA, and conditions for membership (academic and experience) could not be significantly different from current requirements for registration in APEGGA.

Registration of Geology and Geophysics in other Canadian Jurisdictions

3.25 Associations of Professional Engineers, established to regulate the practice of engineering, exist in the other Canadian provinces and territories. Most of these were established in the early 1920s. Up until the 1980s Alberta was the only province to include regulation of the geology and geophysics professions in its Act. But by 1989, two provinces had introduced legislation and others were in the process of doing so.

3.26 In 1979 the Northwest Territories introduced an ordnance, based on the APEGGA act, to regulate the practices of engineering, geology and geophysics. This ordnance was subsequently promulgated as an Act. The requirements for registration are the same as those of Alberta, and APEGGA and its Board of Examiners carry out the registration function on behalf of the Northwest Territories Association (NAPEGG).

3.27 The Association of Professional Engineers of Newfoundland (APEN) in 1984 decided to include the earth science professions in revised legislation. Its decision was the culmination of many discussions that were initiated in the first instance by the geologists and geophysicists working in the province. The matter was discussed at annual meetings in 1982 and 1983. A majority of the geologists and geophysicists favoured legislation for these professions through combining them in the engineers' act, and this was supported by the results of a referendum. In its final report, the Task Force's comments on reasons for combining engineers and geoscientists in one association included: "these two professions

are based on similar bodies of knowledge: mathematics, physics, chemistry and the earth sciences; they are both productive professions; specializations of one easily lead into and/or meld with specializations of the other (e.g. mining engineering, geological engineering, engineering geology); employers of one frequently employ the services of the other".

3.28 The Newfoundland Act received government assent in 1988 and the association became known as the Association of Professional Engineers and Geoscientists of Newfoundland (APEGN).[54] The format and contents of the Act are patterned after the Alberta Act, but there are certain differences:

1. Rather than treating geology and geophysics as individual professions, they are treated collectively as the "practice of geoscience". The definition of practice is similar to what would result by combining the definitions of the practices of geology and geophysics contained in the APEGGA Act. One of the qualifications for registration specified in the accompanying regulations is "a Degree in Geoscience from a university program approved by the Board of Examiners."

2. Professional geoscientists do not have an abbreviated designation assigned as well, as in the case of "P. Geol." and "P. Geoph." in Alberta.

3. There is no Practice Review Board.

4. Permit holders are divided into two classes - A and B. Class A applies to those entities primarily engaged in providing professional services to the public while Class B applies to those *not* providing such services.

5. The Board of Examiners may be divided into two divisions - one to evaluate applications for professional engineers and the other to evaluate applications for professional geoscientists.

3.29 The Saskatchewan, British Columbia and Yukon Associations are in the process of amending their Engineering Acts to include the earth sciences. APES commenced the process in 1987, and although it was fairly well advanced by the end of 1989, some issues were being studied further by government and the geological associations involved. APEBC has revisions in process that were initiated and are being advocated by the thousand or so geologists and geophysicists in that province. These revisions are expected to include geochemists along with geologists and geophysicists as "professional geoscientists". APEYT drafted a revised act in 1988 which, on the initiative of the Yukon Association, included

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[54] *The Engineers and Geoscientists Act*, July 8, 1988, Statutes of Newfoundland.

geologists and geophysicists. It was modelled after the APEGGA Act. A small society was formed to promote the inclusion of these professions - the Yukon Professional Geoscientists Society. Further development is likely to be protracted.

3.30 The Association of Geologists of Quebec was formed in 1968 to group together those persons practising professional geology and form the basis for establishing a professional association. In 1984, it changed its name to the Association of Professional Geologists and Geophysicists of Quebec with the objective of seeking official recognition of these professions. As of 1989, it had a membership of 400.[55]

3.31 This Quebec association issues a news bulletin every three months and holds a general meeting annually. It has its own regulations covering requirements for membership, certificates, seals and stamps, etc. Discussions have been held over the years with the Order of Engineers of Quebec (OIQ) on subjects of mutual interest including the possibility of amalgamating the two organizations. Since OIQ views its responsibilities to protect the public interest as paramount, it has not agreed to such amalgamation. However, when appropriate, cooperative efforts and activities are undertaken jointly.

3.32 Some 5,000 geologists and geophysicists in Ontario are understood to wish to have government legislation to regulate their profession. As of the end of 1989, they have had discussions with the Association of Professional Engineers of Ontario (APEO) about amalgamation under the Ontario Professional Engineering Act. However, since that act had recently undergone a major revision, it seems unlikely that a further change would be made, and if regulation of geological and geophysical practice proceeds to fruition, a separate act is likely to result.

3.33 The Canadian Council of Professional Engineers (CCPE), established in 1936, acts as the national coordinating body for the provincial licensing authorities. Each provincial association pays an annual assessment to CCPE based on the number of professional members it has on its rolls. APEGGA's assessment is based on the number of professional geologists and geophysicists, as well as engineers, in the Association, and a recent clarification of the CCPE bylaws has confirmed that members of all three professions may hold office on the CCPE Board.

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[55] Association of Professional Geologists and Geophysicists of Quebec, correspondence to APEGGA, October 1989.

Chapter 4
Requirements and Criteria for Registration in Alberta [56]

Qualifications Needed to Apply for Registration

4.1 To be eligible *to apply* for registration as a professional geologist or geophysicist, a person must have experience in geological or geophysical work and possess certain minimum academic qualifications. There are two alternate sets of qualifications (Regulation 13), one being a university degree in geology or geophysics plus two years of experience (possessed by most applicants), and the other being an Alberta high school education, or equivalent, of a standard sufficient for admission to an Alberta university program in geology or geophysics, plus three years experience in geological or geophysical work. For the second criterion, graduation from a geological or geophysical technology program can be counted towards the three years of experience required. Applications are screened by the APEGGA Registration Department to ensure these conditions (and those of paragraph 4.4 below) are satisfied before applications are accepted.

4.2 Although the qualifications *required* for registration will be discussed in more detail later in this chapter, it should be noted that persons applying under the first set of criteria above normally will qualify for registration without examinations or with relatively few examinations. Those applying under the second set would normally have to write a large number of examinations.

4.3 An amendment to the regulations is in process (1989) which changes the entry requirement for registration by examination. This amendment raises the entrance requirement from a high school education to:

(a) completion of at least two years of post-secondary education in areas that relate to the science and technology of engineering, geology or geophysics, and

(b) credit or equivalent in an adequate number of fundamental subjects satisfactory to the Board of Examiners.

Notwithstanding the current criteria and the above amendment to it, no individuals have applied to the Association under the examination route (at least in recent years) for registration as a geologist or geophysicist. All have had university degrees.

4.4 In addition to the above qualifications, an applicant for professional membership must be a resident of Alberta who is a Canadian citizen or who has been lawfully admitted to Canada as a permanent resident. If he or she is resident in the province but does not satisfy

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[56] In preparing this Chapter, the Engineering, Geological and Geophysical Professions Act and the accompanying regulations, and minutes of meetings of the Board of Examiners have been referred to.

the citizenship or immigration requirements, or resides outside the province (whether in another province of Canada or elsewhere) then the application is made for "licensee" rather than "professional member".

4.5 In accordance with the Regulations, an application can also be accepted from registered members of other Provincial Associations transferring into Alberta or wishing membership in APEGGA as licensees. The advantages of this rule from the applicant's viewpoint is that the application fee is less, and an application in this category need not be screened initially as the eligibility criteria (academic and experience) are automatically satisfied. On completing the registration process in Alberta they may be designated professional geologists or professional geophysicists if they satisfy the criteria for registration in one of these fields as the case may be.

4.6 Except for the Northwest Territories and now Newfoundland, no other Provincial Association has registered any of its members as professional geologists or professional geophysicists, even though they may be qualified in geology or geophysics. Rather, such individuals have been registered as professional engineers under special rules of the Association to which they were applying. However, some other Canadian jurisdictions are currently planning to amend their legislation to include registration of geologists and geophysicists (see paragraphs 3.25 - 3.33).

Board of Examiners and Application Procedures

4.7 Before discussing the qualifications required for registration as a professional geologist or professional geophysicist, it is appropriate to review the structure and function of the Board of Examiners and procedures for processing applications. The Board is the body which has traditionally appraised academic, experience and other qualifications of applicants for registration. Although its reporting relationships have varied from time to time, the Board in essentially its present form has existed for over 40 years. The Board is established by the Council of the Association under the Engineering, Geological and Geophysical Professions Act of 1981, but is an "arms - length" entity with virtually autonomous powers. While Council can make regulations affecting registration, and can appoint the Chairman and members of the Board, the Board itself operates independently in matters affecting registration.

4.8 Before 1981, the Board of Examiners came under the jurisdiction of the Universities Coordinating Council (UCC). There were arguments both for and against the Board being responsible to the UCC, but the most significant reasons for it becoming a part of APEGGA was that it was more appropriate for the self-governing professions (of engineering, geology and geophysics) to have full responsibility for appraising qualifications and deciding who shall be admitted according to standards set by the profession, and not some independent body or authority.

4.9 Under Regulation 23, the Board of Examiners consists of equal numbers of registered professional members of the Association from the universities in Alberta and from the Association at large, including a Chairman who is from one of the universities. The total numbers are "as specified by Council from time to time", but are based on the number of disciplines being examined and number of applications being received. The Board usually consists of about 35 members. All are volunteers and receive no remuneration.

4.10 The Board includes an executive committee which consists of two-thirds of the members. The executive committee meets monthly to evaluate and decide on applications for registration or enrolment. Members who are appointed from the universities and are on the executive committee review the academic qualifications of applicants and are considered to be members of the "academic committee" of the Board. Members from the "Association at large" who are on the executive committee review the experience qualifications of applicants and constitute the "experience committee" of the Board. The Board meets as a whole semi-annually in June and December to consider matters of policy, significant changes in procedures, examination results and appeals from examination assessments. These meetings are known as "meetings of the full Board". The Chairman of the Board is also the chairman of the executive committee. The Director of Registration - the professional staff officer of the Association responsible for registration - is also appointed to the Board as the Registrar's Designate, and sits at both executive committee and full Board meetings.

4.11 The amendment to the Act of June 1984 provided for a member of the public to be appointed to the Board of Examiners, in a manner similar to members of the public being appointed to the Council of APEGGA and the Practice Review Board. This amendment was introduced to conform to the Government's policy of having members of the public on bodies which set academic standards for entry into the professions. The public member participates in meetings of the full Board, but does not attend executive committee meetings nor take part in appraisal of qualifications.

4.12 The fields of geology and geophysics and each of the major branches of engineering are represented on the Board of Examiners. As of 1989 there were two geology members on the academic committee, one from the University of Calgary and the other from the University of Alberta, and two on the experience committee. The field of geophysics in 1989 was represented by one academic examiner and two experience examiners. The numbers may vary depending on the rate of applications received. In addition, there is one geologist and one geophysicist member from the universities at meetings of the full Board. Thus, applicants for registration as professional geologists and professional geophysicists have their qualifications evaluated by individuals qualified in their two fields (not by engineers), and the two professions have a voice in deliberations of policy and other matters at the semi-annual meetings of the Board.

4.13 As shall be seen later, there are certain academic, experience and other

qualifications required for registration as a professional geologist or professional geophysicist, or for enrolment as a geologist- or geophysicist-in-training. To facilitate proper appraisal, certain documentation is also required in support of the application before it is ready for appraisal by the Board of Examiners. The first step is for an application to be made to the Association on the prescribed form, which among other things includes a detailed experience record and the names of supervisors and references, and a listing of academic qualifications (degree(s), institution(s) and dates of achievement). The required fee must accompany the application. The applicant must arrange for transcripts of academic records to be sent directly to APEGGA from the institution attended, using a form provided with the application package. This has been a long-standing policy of the Board of Examiners to ensure validity of academic credentials. The Association (Registration Department) will screen the application to ensure eligibility, acknowledge it by letter, and write to three of the references/supervisors named on the application to obtain appropriate comments in support of experience. As stipulated on the form, at least two of the references must be professional members of the Association or members of an equivalent professional association.

4.14 The Professional Practice Examination is a requirement for professional membership and it is to the applicant's advantage to complete it as soon as possible after the application has been accepted, providing he or she is qualified to write it. This examination is a multiple choice type with 80% of the questions on topics common to the three professions and answered by all applicants, and 20% on topics specific to engineering, geology and geophysics, selected at the applicant's choice. Applications are screened initially by Registration staff, and if academic and experience qualifications appear acceptable for registration, the applicant is advised to attempt the examination at an early date. In situations where many examinations would be required (e.g. applicants with technology diplomas), then the Professional practice Examination is not written until later in the program of examinations. Applicants who are already enrolled with APEGGA as geologists- or geophysicists-in-training are eligible to write the examination after they have acquired one year's experience after graduation; thus in these cases the examination is likely to have been completed by the time the application for professional registration is received.

4.15 The routes for processing completed applications for professional membership or licensee to the Board of Examiners are shown in Figure 1. The width of the lines indicates the relative proportion of applications which flow via each route. Since there is virtually no accreditation process at present for geology and geophysics programs, most of the applications follow route B in which they are evaluated by the academic and experience committees. The remainder consist of applications for which the programs have been judged by the Board as acceptable, and for these the Board has delegated to the Registrar the authority to refer the application direct to the Board if, in his judgement, the experience is "clearly acceptable" (route A). If the

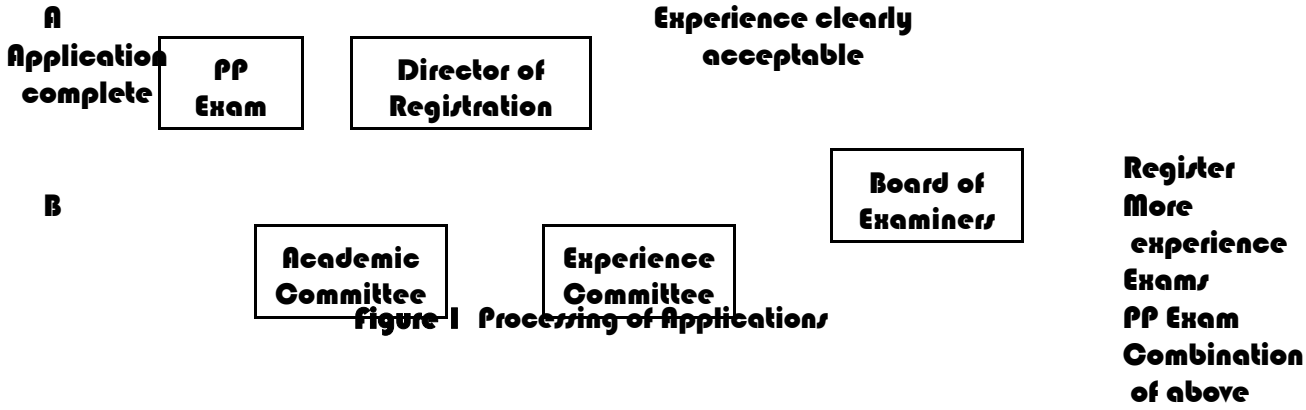

Figure 1 Processing of Applications

Registrar is not sure about the experience, the application is referred to the experience committee and then to the Board.

4.16 Since the executive committee of the Board meets monthly, applications are referred by batches on a monthly basis through the Registrar and committees. Agendas are prepared by Registration Department staff and contain the recommendations of the academic and experience examiners. Applications which follow route A are included on the agenda by list. The executive committee which includes those academic and experience examiners who appraised the qualifications will decide on the basis of the recommendation whether to register the applicant, defer registration and assess more experience, assess examinations, or assess some combination of these. The Board also has the authority to refuse registration if character and reputation is in doubt, but this rarely occurs.

4.17 In addition to dealing with new applications, the executive committee at its meetings considers cases where previously assessed experience or examinations have been completed.

Qualifications for Registration of Geologists and Geophysicists

4.18 The qualifications required for registration as a professional geologist, professional geophysicist or professional engineer are specified in Section 21 (1) (a) to (g) of the Regulations accompanying the Engineering, Geological and Geophysical Professions Act. The academic requirement is of particular significance to geologists and geophysicists.

4.19 Regulation 21(1)(a) currently states this requirement: "a confirmed degree in Engineering, Geology or Geophysics from a university program approved by the Board of Examiners or equivalent qualifications demonstrated by passing such examinations as may be required by the Board". The word "confirmed" means that the degree must be validated or the academic credentials verified through transcripts submitted directly to the Association from the university attended. Experience several years ago with applicants who submitted so-

called "original academic documentation", which subsequently was found to have been falsified, led to the introduction of this policy.

4.20 Curricula and course content of geology and geophysics programs at universities in Canada have varied widely, even for programs at the University of Calgary and the University of Alberta. It was impractical for the Board to identify those programs that would be acceptable as minimum academic standards for registration. However, four-year honours degree programs were considered to be acceptable programs to meet requirements for registration as a professional geologist or professional geophysicist, and based on these programs a syllabus of examinations in each field was developed in the 1960s by the Board of Examiners, to be utilized as reference criteria against which the academic qualifications of applicants for registration could be assessed, and for assessing examinations in areas where academic deficiencies existed or where confirmation of qualifications was needed. There were many ways or program arrangements which did not conform to the syllabus requirements that could lead to a program acceptable for registration, and the syllabus was intended to serve as a guide for the academic examiner when an assessment was being made. These syllabi were updated in 1973, in 1981/82, and most recently in 1986 (geology) and 1988 (geophysics).

4.21 As originally written, the educational qualifications specified in Section 21(a) of the Regulations were limited to two, i.e. a university degree or completion of examinations. Yet many individuals wishing registration as professional geophysicists have degrees in mathematics, physics or a similar discipline which satisfy the Board's educational requirements for registration. Other individuals have completed all the university courses to satisfy the requirements (for engineers and geologists as well as geophysicists) but do not have a degree. Therefore an amendment to the regulations was developed in 1988 and is in the process which adds a third provision to Section 21(a):

> "... or university qualifications acceptable to the Board of Examiners in a related program..."

Related Sections 1(b) ("confirmatory examinations"), 1(d)(i) (qualifications necessary to apply for registration) and 16 (definition of examination candidate) which are affected by this change are also being amended.

4.22 Until about 1982, the academic records (transcripts) of every applicant for professional geologist and geophysicist were reviewed by the academic examiner relative to the syllabus. Compared with the registration process for engineers, this was an onerous task. In the case of engineering, the Canadian Engineering Accreditation Board (CEAB) had been in existence since 1965, had developed academic criteria acceptable for registration as professional engineers in Canada, and had regularly reviewed engineering programs at Canadian universities relative to this criteria. Lists of accredited engineering programs were available and were periodically updated. The programs recommended by CEAB were

acceptable to the Board of Examiners and considered as "university programs (in engineering) approved by the Board", eliminating the need for a review of individual transcripts by the academic examiner - only certification of degree was required. However, as shall be seen later, steps have been taken within the last few years by the APEGGA Board to introduce a form of limited accreditation for geology and geophysics programs.

4.23 Prior to passage of the Engineering and Related Professions Act in March 1960, and the introduction of the professional designations P. Geol. and P. Geoph., the Board of Examiners decided to continue its practice of accepting only four-year graduates without examination; three-year and partial four-year graduates would be assessed on a subject for subject basis. Academic committees in geology and geophysics were directed to prepare listings of acceptable programs and institutions in Canada and prepare similar information on programs/institutions in other countries. For geology, the result was the "Stelck list" originated by Dr. Charles Stelck, P. Geol., which was utilized for the next decade or so.

4.24 In 1975, the Board decided to accept as academically qualified those applicants who had:

1. an Honours Geology or Honours Geophysics degree from a Canadian university, and

2. a B.Sc. with specialization in Geology or Geophysics from the University of Alberta.

It was subsequently found that the content of these programs continued to vary, hence this decision was revoked and the Board reverted to its previous practice of complete review of transcripts, which continued as far as geology was concerned, up to the time of the next revision of the geology syllabus (1981).

Geology - Academic Requirements

4.25 In 1981, the geology syllabus was revised by the Board of Examiners, based on the content of Honours B.Sc. geology programs at 19 Canadian universities. The subcommittee which did this work was composed of three academic members of the Universities of Calgary and Alberta and two professional geologists from industry. The number of exams that a candidate with no exemptions would be required to write was raised to 26 from 17 in the previous (1973) syllabus; this number was comparable to an increase in examinations for engineering candidates resulting from a revision to the CCPE uniform syllabus which was introduced in 1979. In reviewing this syllabus, the Board noted that it might be considered as a beginning of an accreditation program across Canada for geology, and that there was much confusion across the country on the differences between professional registration and technical society membership.

4.26 The review of the Honours B.Sc. Geology programs carried out by the 1981 subcommittee also resulted in a form of "limited APEGGA accreditation" of many of these programs. Thus anyone graduating from such programs in 1978 and subsequently would be academically qualified for registration as a professional geologist. Applicants with geology degrees other than honours would not necessarily satisfy the academic requirements without examination: for example a straight B. Sc. with a major in geology from the University of Calgary may be short some of the required courses. Students undertaking non-honours geology programs at the University of Calgary would however satisfy registration requirements if the correct courses were chosen initially, as counselled by academic staff.

4.27 There was also doubt that the honours programs as evaluated by the subcommittee would remain unchanged. In the case of engineering a sound system of control, through accreditation, was in effect. The same was not true for geology. Therefore, the Board would subject the programs to review at two-year intervals.

4.28 A comment should be made about geology programs offered by the University of Calgary. Two programs have been offered - a B.Sc. Honours and a B.Sc. with a major in geology. The first is a four-year program, a graduate of which will satisfy the academic requirements for registration. This program was the only one in effect at the time the Engineering and Related Professions Act, which required Alberta graduates to be registered, was introduced. The second usually contains a limited number of full courses in geology and a small number of fundamentals, in most cases the numbers being considerably less than the requirements of the syllabus although the core courses have usually been taken. A number of 1982 graduates applying for enrolment as geologists-in-training had undertaken the B.Sc. major program and therefore were assessed some examinations to make up for academic deficiencies. These 1982 graduates were admitted before the University of Calgary quota system was introduced and were, it is understood, informed by the Department of Geology and Geophysics that the required minimum in a geology program would not necessarily satisfy APEGGA's registration requirements. These individuals, however, were reassessed by the Board according to the previous syllabus (1973) which had been in effect during the period of their attendance and which generally resulted in elimination or reduction of the number of examinations.

4.29 In 1985 the 1981 geology syllabus was reviewed again by a subcommittee of the Board of Examiners. The number of examinations required remained unchanged but flexibility was introduced in the professional level subjects by modifying maximum and minimum requirements. The descriptions for examinations and textbook lists was upgraded and updated. The syllabus was approved by the Board as the 1986 edition and consists of examinations in the following content areas:

Examinations in Fundamentals	-	11 subjects: 6 required - 3 compulsory and 3 optional of

remaining 8.

Examinations Specific to Geology -

Section A - Core Subjects	-	**10 compulsory exams on subjects basic to a geology education.**
Section B - Major Options	-	**8 subjects: minimum of 5 required.**
Section C - Advanced Options	-	**14 subjects: minimum of 2 and maximum of 5 required.**

Ten exams in total are required from sections B and C.

4.30 The 1986 syllabus subcommittee also revised the list of Honours B.Sc. Geology programs. Currently (1989) there are 22 such programs at Canadian universities that will satisfy the academic requirements for registration as a professional geologist. The same subcommittee also developed listings of geology courses at Canadian and US institutions that the Board accepts for purposes of registration.

Accreditation of Geology Programs

4.31 In 1984, under the initiative of John B. Maher, P. Geol., the CSPG (being a national body) proposed a program to bring about nationwide accreditation of degree programs in geology at Canadian universities in a manner similar to the CEAB and ABET accreditation system for engineering. The objective of such a system would be to facilitate appraisal of academic qualifications for professional registration of geologists in the Canadian provinces. It would also aid prospective students entering university geology programs to select the right courses of study to allow registration (without examination) when they had obtained their degree, and would facilitate mobility of professional geologists transferring from province to province. The latter was becoming important as other provinces besides Alberta were beginning to register geologists.

4.32 The proposal - for the establishment of a Canadian Geological Accreditation Board under the auspices of the Canadian Geoscience Council (CGC - see paragraph 6.18) - with

draft terms of reference was presented by Mr. Maher to the CGC.[57] It received considerable attention during meetings of the CGC held in 1985 with particular and detailed scrutiny by the Council of Chairmen of Canadian Earth Science Departments (CCCESD), an associate member of CGC.[58] Also, the proposal was considered in depth by the Chairman of University Geology Departments in Ontario (CUGDO).

[57] CSPG, *Proposal for the Establishment of a Canadian Geological Accreditation Board*, October 1984.

[58] Canadian Geoscience Council, *Annual Reports 1985, 1986, 1987*

4.33 Accreditation of geologists proved to be a very controversial topic. There was confusion in the minds of many Canadian earth scientists between registration and accreditation. A small committee under the chairmanship of John Maher was established to deal with the proposal, but in the end both the CUGDO and the CCCESD expressed their opposition. The CCCESD's formal position may be found in the document forwarded to the CSPG by its Chairman, Dr. A. E. Beck, and published in the CSPG Recorder.[59] Among other things, there was concern that accreditation would restrict the freedom of individual departments to define their own curricula; that there would be pressures to introduce more applied aspects of the profession at the expense of the basics; that the system might tend to infringe upon academic freedom generally.

Geophysics - Development of Requirements up to 1985

4.34 Before 1985, what constituted acceptable academic qualifications for registration as a professional geophysicist was a matter of concern for the Board of Examiners and had been the subject of discussion for many years within the geophysical community. The academic programs for professional degrees such as law, divinity, medicine, engineering or the like are definite and distinct, whereas those of many applicants for registration as geophysicists are often vague and diffuse.

4.35 To provide for the registration of competent geophysicists who had academic backgrounds in engineering (before geophysics programs were introduced in universities), the Board in 1960 adopted a general rule that a person with a B. Sc. in engineering obtained before 1955 would be academically qualified for registration as a P. Geoph. providing the major portion of his subsequent experience had been in geophysics. As time went on, in spite of an increase in the number of geophysics degree programs offered at universities, more and more individuals having science-based degrees in other fields entered the practice of geophysics and desired professional registration.

4.36 The subcommittees of the Board dealing with this matter concluded that the requirement for registration as a geophysicist was a four-year honours or specialization degree in the physical sciences which included some geology and geophysics. However it was recognized by the Board that there were many programs that did not conform to these requirements, yet were acceptable for registration in a broad sense. Therefore the academic examiner must have a wide latitude in reaching what is often a subjective opinion on the

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[59] CCESD Document, *The Licensing and Registration of Individual Geoscientists* - The Official Position of the CCESD, 1986 - 87 Executive, CSEG Recorder November 1986

acceptability or otherwise of a specific degree. Notwithstanding, examiners needed some guidelines to assist in making assessments and in 1977 the "Gretener Rule" was developed. Dr. Peter E. Gretener, P. Geol., P. Geoph. was chairman of the subcommittee which stated:

1. Graduates with degrees in mathematics, computer science or physics may apply for registration as P. Geoph. after obtaining a minimum of one year of geophysical experience, and would be assessed six examinations from the (1973) geophysics syllabus, then reassessed after writing once only.

2. Applicants with academic degrees from recognized institutions shall be assessed in the spirit of the syllabus i.e. any geophysicist should be trained in the fields of mathematics, physics and geology, the relative proportions to be subject to variations within limits.

4.37 The geophysical community was still generally dissatisfied with APEGGA's policies for evaluation of applications for professional geophysicist, and in 1980 APEGGA president Roy O. Lindseth, P. Geoph. requested that the Board consider the matter of registration of geophysicists whose principal degree is in something other than geophysics. In response to this request, the Board set up a subcommittee of geology and geophysics members plus professional geophysicist representatives from industry, which considered this question in considerable depth. The subcommittee was chaired by Dr. Gretener. In the course of its deliberations several draft reports were produced, other members from industry were added to the subcommittee, and opinions of geophysicists experienced in certain specialized areas were obtained. At one stage a survey of geophysicists registered with APEGGA was conducted.

4.38 There was considerable difference of opinion within the subcommittee, but in the end a majority report was approved by the Board and introduced in 1982 which covered the following areas. Candidates not exempted from examinations would be required to write a total of 24 compared to 17 in the previous syllabus. The CSEG was given the opportunity to comment on the new syllabus, but it had few objections.

1. Fundamentals - 11 compulsory exams.

2. Core Subjects - 9 compulsory exams on subjects basic to a geophysics education.

3. Major Options - 4 exams required from a total of 13, or alternatively, submission of a written paper or report on selected topics in geophysics acceptable to the Board.

4.39 A review of geophysics programs at Canadian universities carried out in 1982 showed, as in the past, significant differences in the content of a number of programs. Therefore the

practice of having the transcripts of applicants for P. Geoph. reviewed by the academic examiner in geophysics was continued until a further evaluation made in 1983 showed that some programs were acceptable, allowing a "limited APEGGA accreditation".

4.40 The Board's procedures reflect Regulation 21 (1) (b) accompanying the 1981 Act, i.e. a "confirmed degree in *geophysics* from a university program approved by the Board of Examiners or equivalent qualifications demonstrated by passing such examinations as may be required by the Board". However, a temporary relaxation in the academic requirements for registration as a professional geophysicist was introduced in 1982 as one of the results of a special task force established by Council to examine experience and other requirements for admission to the Association. Known as the "McManus Formula", it allowed applicants who applied by January 1st, 1984 to be registered without examination if the following conditions were satisfied:

1. they held a degree from a university recognized by the Board of Examiners in a field of science related to their area of practice;

2. they had at least 6 years of experience of an increasingly responsible nature satisfactory to the Board after graduation; and

3. the Board assessed the total package of academic and experience qualifications as being sufficient to meet the minimum requirements for registration.

Revised Geophysics Syllabus

4.41 The McManus route was closed January 1st, 1984, but the policies of the Board of Examiners respecting the academic requirements for registration of geophysicists with non-geophysics degrees were perhaps not as "rigorous" as before. But some segments of the geophysical community continued to have concerns about the academic requirements for professional geophysicist registration. As one of the activities of the CSEG/CSPG/APEGGA Liaison Committee (see paragraph 2.23), a subcommittee was established in 1984 to consider this topic and make recommendations, through the Liaison Committee, to Council and the Board of Examiners. Membership of this subcommittee was diverse and consisted of three persons appointed by the CSEG, one appointed by the CSPG, one appointed by the Liaison Committee and one academic representative (P. Geoph.). Advisors to the subcommittee were two professional geophysicist members of the Board of Examiners.

4.42 The subcommittee, in dealing with this matter, first developed a set of guidelines for program content, similar to CEAB's programs in engineering, which would apply to geophysics in a broad sense. The document was initially drafted by Dr. Ken West, P. Geoph.,

one of the subcommittee's CSEG appointees. Inputs were received from universities in Canada and the USA regarding content of their programs related to geophysics. From the program content document, an outline for a revised geophysics syllabus was developed, followed by the detailed syllabus.

4.43 It was agreed at the outset that the syllabus should be multidisciplinary within an overall "geophysics" connotation. The subcommittee took into account the perceptions of some people in the geophysical industry that the existing syllabus was too rigid, and aimed to develop a syllabus that reflected the various domains of the practice of geophysics.

4.44 Over the next several months from about mid 1985, a geophysics syllabus outline proceeded through several draft editions. In the course of its development, comment was obtained from a number of senior geophysicists in academic circles and in industry. The final stage in development of the syllabus outline was a review by a committee of the CSEG, which gave its blessing in July 1986. Both the program content document and syllabus outline were then submitted to the APEGGA Council where they were accepted and referred to the Board of Examiners. The Board accepted the program document for use as a guideline and accepted the syllabus outline as a basis for a detailed geophysics syllabus. The outline was then developed into the 1988 syllabus.

4.45 The syllabus covers the three levels of qualification - fundamentals, core subjects and major options. Within these three levels, subjects have been appreciably broadened so as to include a wider range of geophysics programs that would be more readily accepted by geophysicists. The most significant changes were in the major options in which several fields of geophysical specialization are covered. Also, while a greater variety of academic backgrounds is encompassed, the syllabus does not presume to register geophysicists by area of academic specialization. The six-year experience concept which was introduced by the 1981 McManus Task Force is also preserved. The syllabus consists of the following topics:

1. Fundamentals - 8 examinations equivalent to those normally taught during a degree program in the physical sciences or engineering. This section was broadened to make the coverage less narrow and some subjects were combined or removed.

2. Core Subjects - 9 examinations in areas of geology, physics and mathematics which represent the core of geophysical training.

3. Major Options - 6 examinations of the candidate's choice in one of: general geophysics, petroleum geophysics, seismology, mining geophysics, petrophysics or engineering geophysics. Each consists of 10-13

topics.

4.46 The detailed syllabus was subsequently presented to the CSEG/CSPG/APEGGA Liaison Committee and CSEG who concurred with it.

4.47 Completion of the 1988 geophysics syllabus also encompassed a review of the list of geophysics programs at Canadian universities. In 1989 there were 10 such universities (including one in the USA - Colorado School of Mines) and 15 programs.

4.48 The preceding discussions described criteria which was theoretically designed for either: persons who had only a high school education and planned to be registered via the examination route, or who had a university degree in geophysics from a Canadian university. But in the actual situation there are many individuals who possess academic qualifications in between these two extremes and possess varying kinds of geophysical experience. (This is why Section 21 (a) of the Regulations is being changed - see paragraph 4.21). The Board of Examiners utilizes the following policies in handling such situations. These policies include a modified version of the Gretener Rule (paragraph 4.36).

Bachelor Level Qualifications

1. In the case of applicants having geophysics degrees from institutions in Canada other than those stated in the Board's list and elsewhere, transcripts are examined relative to the syllabus. If content as appropriately documented is judged acceptable, academic qualifications are deemed satisfactory. Otherwise, course-by-course (note (a)) or confirmatory (note (b)) examinations are assessed.

2. Graduates with geophysical experience and degrees in fields related to the practice of geophysics will be assessed course-by-course (note (a)) examinations according to the syllabus. If geophysical experience is six years or more, the exams will normally be confirmatory.

3. Graduates in geology, mathematics or physics with 4 year degrees acceptable to the Board and six years of increasingly responsible geophysics experience may be considered to meet the requirements for registration. In cases of doubt, confirmatory (note (b)) examinations will be assessed.

4. Generally, experience is separate and distinct from academic qualifications, and cannot be used to make up for academic deficiencies.

Bachelor, Supplemented by Advanced Degrees

1. Content of all programs is examined relative to the syllabus. If total content is judged acceptable, academic requirements are acceptable. Otherwise examinations are assessed. Applications are usually treated on an individual basis. If the subordinate degree(s) is acceptable for registration, the advanced degree(s) counts towards experience.

Special Cases

1. In exceptional cases, where the applicant has limited academic qualifications but many years of continuous experience with a clear record of increasing responsibility and outstanding professional reputation and stature, the Board may accept the total package of academic and experience, or alternatively require two examinations or

completion of a report at the Board's discretion.

Notes

(a) Course-by-course exams are assessed when there are clear academic deficiencies relative to the Syllabus. A maximum of four attempts are permitted for each exam.

(b) Confirmatory exams are assessed when the subjects of the program appear equivalent to Syllabus subjects but content is unknown. Each exam assessed is attempted once; if all are passed academic requirements for registration are satisfactory.

Concluding Remarks

4.49 Inclusion of the geology and geophysics professions under the professional act presented some challenging problems for the Board of Examiners, particularly with respect to academic requirements for registration. Engineering had a common set of branches or subdivisions and program curricula that was generally recognized throughout Canada and the USA. All Canadian provinces and American states had been registering engineers for several decades and national accreditation boards had been established which formulated sets of engineering program criteria for use as a basis for judging academic qualifications for registration. Such was not the case for geology and geophysics. While programs of studies existed at the Universities of Alberta and Calgary, content varied and in some cases did not satisfy what was judged by the Board as needed to qualify as a professional geologist or geophysicist. Registrants intending to practice in Alberta who were graduates from other provinces often had qualifications which were also diverse.

4.50 Although the two professions have always been represented on the Board of Examiners by experience and academic examiners registered as professional geologists and professional geophysicists, the development of appropriate qualifying criteria for registration was a long and tedious process. To meet the obligations to the public under the Act, it was necessary that requirements be set at a high standard, and this philosophy was maintained. Yet the Board was consistently receptive to representations from the geophysical and geological communities and was prepared to change the qualifying criteria providing the high standards were not compromised.

4.51 Development of the geology and geophysics syllabi which culminated in the 1986 and 1988 editions are the results of much dedicated effort on the part of the Board and members of the geological and geophysical community. Alberta is considered to currently have a rigorous system of assessing credentials relative to criteria of high standards acceptable to the professions. Now that other jurisdictions are beginning to register geologists and geophysicists, further developments leading to accreditation of geology programs should enhance this system.

Chapter 5
Professional Practice - Principles, Practices and Techniques

General

5.1 There is an abundance of published material available on professional practice as it relates to the engineering profession. Similar material applicable to the professions of geology and geophysics has been very limited. Perhaps this is because geology, and to a greater extent geophysics, have historically had less impact on public safety than engineering, and have been regarded more as pure rather than applied sciences. But because they are professions (Chapter 1), and have a definite impact on the public interest (Chapter 3), the establishment of professional practice guidelines that are specific to these two professions is a desirable goal. The scope of geophysical and geological activities, the development of new technologies in these fields, and the increasing number of persons entering the professions are additional reasons in favour of setting out some general principles and techniques. Awareness of professional liability, a knowledge of professionalism and ethics are also areas which are important for geologists and geophysicists.

5.2 This chapter approaches the topic by making some general remarks about the need and scope of professional practice guidelines for the geology and geophysics professions, describing some general principles that should be followed, and concludes with articles by senior professionals on three specific areas of practice.

Need and Scope of Professional Practice Guidelines[60]

5.3 Many geologists and geophysicists, either individually or by team effort, provide professional services which consist of investigations, conclusions and recommendations. Clients spend money to achieve desired goals which often are associated with public welfare, such as health, housing, transportation or mineral extraction. It is of prime importance to the profession that they understand the impact of their work on society. Geologists and geophysicists must provide professional work in a form that is thorough and accurate within the limitations of current professional practice. Geological and geophysical work which meets these goals may be considered a means of reducing liability exposure and an aid in loss prevention.

5.4 Professional liability should be an important issue to all professional geologists and geophysicists, since the recourse to legal action has unfortunately become commonplace in the settlement of disagreements which may arise during or after a project is completed. It has become abundantly clear that most of the legal actions which are involved, or may potentially involve, geologists or geophysicists concern either the quality and/or competence

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[60] Association of Engineering Geologists (AEG) *Professional Practice Guidelines*, 1981, (valid as of 1989). Adapted from Chapter 1 with permission of AEG.

of a work product, or are of the "third-party" variety. In third-party suits, all parties to the contract are brought to court in the plaintiff's efforts to find monetary redress through blanket suits.

5.5 The best protection that professional geologists and geophysicists can have in effectively reducing liability exposure, and costly and time-consuming involvement in legal actions, is to maintain professional standards in practice and to develop an awareness of professional liability. A job prudently conducted at the state-of-the-art level of technical competence, according to well-defined items of scope, and in good communication with the client, serves both as a measure of the competency of the practising professional and as an aid in reduction of liability exposure and loss prevention.

Professional Development

5.6 From the very start of professional practice, whether as an independent consultant or as an employed geologist or geophysicist, it is advisable that each evaluate his or her technical competence, in terms of abilities, experience, educational background, and chart a personal plan of ongoing professional development.

5.7 An important aspect of self-evaluation of technical competence is that each geologist and geophysicist should establish the technical bounds of his or her competence. They *can* be held liable for not recognizing their own shortcomings and should either refrain from practice in certain applied fields, or strive to increase technical competence where necessary. Competence is gained through background study, participation in instruction or technical meetings, careful application of the techniques in practice, close cooperation with more knowledgeable colleagues and demonstration of this understanding with and before others, such as writing and giving papers. Friendships and acquaintances developed in APEGGA and technical societies should be pursued in the form of discussions or cooperative field work.

5.8 Personal professional development should be undertaken by assessing the key elements of professional practice important to each person's career and then establishing the means of attaining sequential goals in the area of key elements. A plan for professional development should address all of the elements of professional practice. The key elements include:

1. the techniques of technical practice;
2. a personal philosophy of application of each technique;
3. an ability to communicate with others;
4. a willingness to establish and meet deadlines;

5. a commitment to meet the full letter of agreements; and

6. an effort towards continuing education.

Techniques of Professional Practice

5.9 Professional geologists and geophysicists are expected to be knowledgeable of current techniques in their field of practice and be capable of applying these techniques to the satisfactory solution of problems or other needs of the client or employer. An understanding of the basic theories and practices of allied fields and disciplines or specialities, provides a familiarity with what data is required by each type of client or the employer, and the ability to provide answers and solutions.

5.10 *Philosophy of Application* The professional geologist and geophysicist should develop personal philosophies of understanding and application of each technique, theory or procedure that is used in daily practice. This may provide a basis for supplying expert testimony that is ethical, accurate, understandable and to the point.

5.11 *Communication* Effective communication is vital in professional practice. No matter the extent of one's knowledge, the inability to communicate it clearly and succinctly makes that knowledge of limited use. Endeavours in which job-related communicative skills are exercised include public speaking, effective coordination for group meetings, record-keeping practices and clear and objective writing.

5.12 *Establish and Meet Deadlines* One element of good professional practice is to understand the client's or employer's needs and then to satisfy those needs in a competent manner, on time and within budget. Learned project management skills may be applied to achieve goals and objectives. Meeting the established deadlines within the budgetary restrictions of a project is aided by such management skills as organizing, administering and controlling staff member participation.

5.13 *Commitment to Agreements* Incidents related to professional liability leading to disciplinary proceedings have generally been linked to a misunderstanding of the client's needs, poorly prepared proposals, negotiations and contracts, and work products which, in some way, did not meet the client's objectives of the terms of the contract. In this connection, Chapter 18 of the text "Law for Professional Engineers" provides appropriate guidelines on this subject.[61] A standard form of client/consultant agreement developed by APEGGA for use as a guide by APEGGA geologist and geophysicst members is in Appendix B.

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[61] D.L. Marston, *Law for Professional Engineers*, (McGraw-Hill-Ryerson Ltd., 1985), Chapter 18 "The Agreement between Client and Engineer".

Continuing Education

5.14 A program of continuing education which includes pursuit of graduate degrees, attending APEGGA's Professional Development Seminars, attending special or short courses and technical meetings, participation in field trips, home study of journals and textbooks and membership in geological/geophysical societies provides a means for geologists and geophysicists to grow professionally for the entire tenure of their professional practice. The continuing education programs organized by the CSPG and CSEG are especially noteworthy (see Chapter 6). Additionally, each should acquire and maintain a professional library of reference material that should be used continually as the basis of his or her state-of-the-art technical assistance to the client or employer. If personal resources are limited, access to a good library is invaluable and usage of it is essential.

5.15 Geologists and geophysicists must recognize participation in the profession as a serious undertaking, which requires continued and substantial commitment beyond the baccalaureate degree. With a plan for professional development, they will be in a position to further recognize that continued professional development is absolutely essential as a means of effectively reducing professional liability and of maintaining a professional standing.

Ethics

5.16 Every professional geologist and geophysicist should strive to practice the profession in accordance with ethical standards of conduct, whatever organizational level, employment sector or specific activity he or she may be categorized or engaged in. APEGGA's Code of Ethics should be used as a basis for ethical practice.

5.17 Some of the geological and geophysical technical societies and institutes have codes of ethics. While the phraseology and wording is different, the general principles are essentially the same as the principles reflected in the APEGGA Code. Both the CSEG and CSPG expect ethical conduct on the part of their members - CSEG members are expected to "conform with established principles of professional ethics"; CSPG members should be "guided by the highest standards of ethics, personal honours, scientific integrity and personal conduct."

5.18 Many of those US states which have legislation to regulate the practice of geology also have codes of ethics embodied in their legislation (see Chapter 7).

5.19 The APEGGA Code of Ethics, as revised in 1987, is contained in Schedule A of the Regulations accompanying the Engineering, Geological and Geophysical Professions Act, and is repeated in Appendix C. It consists of brief statements of ethical principles in the form of a Preamble and 11 enforceable Rules of Conduct. Supplementary to the Code, APEGGA

has published a "Manual of Professional Practice under the Code of Ethics" which is an interpretive document that exemplifies the Code.[62] In it each article of the Preamble and the Rules of Conduct is repeated, followed by further guidelines and commentary to assist APEGGA members in dealing with ethical situations and to assist all professionals in their understanding and application of the Code. After the commentary on each rule, case studies of typical ethical examples are included.

5.20 The codes of ethics of two major US geoscience organizations, the Society of Exploration Geophysicists and the American Institute of Professional Geologists, are reproduced in Appendices D and E. The introductory portions of these codes are worth repeating:

Society of Exploration Geophysicists

The Constitution of the SEG, Article IV, Section 1, states that "Membership of any class shall be contingent upon conformance with the established principles of professional ethics". As an elaboration of these principles, the following Code of Ethics is enunciated. It shall be your duty as a geophysicist, in order to maintain the dignity of your chosen profession: (followed by nine articles).

American Institute of Professional Geologists - Parts of the Preamble:

Members of the American Institute of Professional Geologists are dedicated to the highest standards of personal integrity and professional conduct. The Institute's Code of Ethics comprises three parts: the Canons, which are broad principles of conduct; the Ethical Standards, which are goals to which Members aspire; and the Rules of Conduct.

The Code of Ethics applies to all professional activities of Members, wherever and whenever they occur. A Member shall not be relieved of any ethical responsibility by virtue of his or her employment, because the Member has delegated an assignment to a subordinate, or because the Member was not involved in performing services for compensation.

Submission of Reports for Securities Commissions

5.21 Geologists and geophysicists are frequently involved in preparing and submitting reports on mineral and oil and gas properties to Canadian Securities Administrators. Detailed policies covering such submissions are contained in National Securities Policies No. 2-A and 2-B which are reproduced in Appendix F. Policy 2-B, which was issued in 1982, was a direct result of the deliberations of an APEGGA Task Force chaired by G. J. De Sorcy, P. Eng., of the Energy Resources Conservation Board. A summary of the major points stated in these policies is given below. Complete details are contained in Appendix F.

Reports on Mining Properties (Policy 2-A)

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[62] **See footnote 16.**

5.22 Reports must be factual and the recommendations must be warranted based on the information and data contained therein. The author must state that in his judgement, the venture is of sufficient merit to make it a worthwhile undertaking. Authors with professional affiliations will use their seal. Where the proceeds of the issue are being applied to the property being reported upon, the person making the report must be free of any association with the issuer.

5.23 *Source of Information* **If any of the information is not based on the author's own observations and investigations, their source should be clearly stated, giving the exact reference to reports and records, with copies attached as appropriate. Whenever reasonable and practicable, reports must be based on the author's personal inspection of the property being reported upon.**

5.24 *Content* **A complete report should include a description of the properties of the issuer in accordance with the requirements of the appropriate provincial legislation and should contain all pertinent exploration data including plans and sections. (Headings, format and detailed content of the report are described in the policy.) The information supplied in the report should be sufficient and positive enough to warrant the recommendations made. An estimate of the costs for the proposed program should be included. Reports must be well illustrated by plans and by sections to give an adequate picture of the property. In case the potential merit of a property is predicated on geophysical or geochemical results, maps showing results of the surveys and the interpretation should be submitted.**

5.25 *Consent to Use of Name in Prospectus* **Where the author of the report or valuation is named as having prepared or certified any part of a prospectus or is named as having prepared or certified a report or valuation used in connection with a prospectus, the written consent of such author to its inclusion shall accompany the report on valuation. It is the responsibility of the author when giving such consent to have assured himself that it can properly be given.**

Oil and Gas Reports (Policy 2-B)

5.26 As for mining reports, reports must be factual and the recommendations must be warranted based on the information and data contained therein. The author must state that in his judgement, the venture is of sufficient merit to make it a worthwhile undertaking. If any of the information is not based on the author's own investigations and observations, their source shall be clearly stated, and reference made to records and reports with the author stating the degree of reliance he has placed on them. (Headings, format and detailed content of the report are described in the policy.)

5.27 If principals in an independent consulting firm which prepared the report have or will acquire direct or indirect interests in properties or securities of the issuer or any associate or affiliate of the issuer, such interests must be clearly disclosed in the report.

5.28 Reports shall be prepared only by a registered professional engineer or a registered professional geologist who is independent of the issuer or any associate or affiliate of the issuer. Notwithstanding, in-house reports may be accepted at the discretion of the Director of the Securities Commission, but only for large well-established issuers.

Employees as Professionals

5.29 The viewpoint is often expressed that geologists and geophysicists who are employees in large corporations need not be registered. These excerpts from an article by David T. Irving, P. Eng., President of APEGGA 1989-90, provides a different view and conveys APEGGA's position on this matter.[63]

> **Our Association is made up of some 25,000 members with over 80% of them being what would be referred to as employee members - members who report directly to an employer rather than to the public at large. This large segment of our membership consists of members in a diverse range of positions, from the new graduate to the chairman of the board of a corporation. The size of employer varies dramatically from small businesses with fewer than five employees to multi-billion dollar corporations with many thousand employees.**
>
> **Our members are also trained in different disciplines within their individual profession. Many have gone down the management path rather than the technical path in their careers - some still supervising or managing professionals, but not carrying out directly, the activities of the profession with hands-on effort. These employees very often work within guidelines set by their organization and have little exposure or involvement with their Association.**
>
> **The Government of Alberta has delegated the responsibility to the Association to regulate and control our own membership entrance requirements, the activities of our members and most importantly, to ensure to the public that the quality of service that they are receiving from a member of the Association is of high standard and comes from a person who is fully trained in the area of expertise claimed by the individual.**
>
> **The employee member, while not offering services to the general public in a direct manner, certainly undertakes professional activities within the corporation that fall within the Code of Ethics under which all members must operate. The practices of engineering, geology and geophysics are defined in our Act and are broad enough to include most of the technical activities carried out by professional members who are employees of organizations. As professionals, we must take responsibility for our own work and ensure that it is accurate and acceptable by the organization while being safe for the public at large.**
>
> **It is also the responsibility of each engineer, geologist or geophysicist to recognize that his or her employer has certain goals which must be reached, whether these be goals of profitability, efficient operation, personal satisfaction, service of customers, effective public relations and**

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[63] **David T. Irving, P.Eng. "Can an Employee be a Professional?" *The PEGG*, October 1989, pp. 2, 3.**

good employee relationships. The engineer, geologist and geophysicist must realize that "professional" is not just status which is automatically attained by the granting of a certificate by the Association of Professional Engineers, Geologists and Geophysicists of Alberta, but a personal standard of performance which must be demonstrated through enthusiasm, ability, leadership and willingness to accept responsibility. The fact that he or she is talented or well-educated will earn no personal recognition unless his or her education and abilities are satisfactorily applied to the good of the employer's organization. Recognition as a true professional can only come through effort and contribution. Employee members need to adopt the employer's mission as their own and dedicate their entire working energies to the employer. If they cannot accept, for various reasons, the employer's raison d'etre, the professionals have no choice but to change employers.

As a professional, the employee engineer, geologist and geophysicist also has certain expectations of the employer. These goals include the need for personal achievement, opportunity for advancement, a satisfactory salary level based on their contribution to the organization and the responsibilities he or she is required to assume, and the necessity to be considered a person of stature among other employees. It is the definite responsibility of the employer to show an intention to recognize professionalism in the employees, and that careers can be supplied which will give adequate challenges.

The employer must recognize that a professional engineer, geologist and geophysicist has a Code of Ethics set by the professions and under which the professional must work. If there is conflict with the Code of Ethics and what the employer wants the professional to do, then the Code must prevail.

Although the public may not be aware that the regulatory authority for our professions is APEGGA - rather than the provincial government - the public has an appreciation that individuals who hold themselves out to be Professional Engineers, Professional Geologists or Professional Geophysicists operate under a Code of Ethics and follow high professional standards. The use of the title P. Eng., P. Geoph. or P. Geol. after their name shows the public that they have high ethical standards in their work and hopefully in their personal life. This creates a status for them and their organization.

The public also recognizes that members of a professional organization who do not live up to the standards set by their professional organization are subject to disciplinary action and corrective directional coaching.

The employed registered engineer, geologist or geophysicist can proudly say "I have obtained qualifications which have been examined by my peers and found adequate, and I have undertaken to practice my profession in the best interest of my client, employer and the public in accordance with the Code of Ethics adopted and enforced by my own profession."

Expert Witness Duty

5.30 Serving as an expert witness is an activity which professional geologists and geophysicists are likely to encounter in their practice. Mr. James R. Dunn, CPG, Chairman of a New York consulting geology firm, wrote a pertinent article in Geotimes on this subject. Excerpts from his article are repeated below:[64]

> Society needs the special knowledge of geoscientists for public hearings, litigation, making laws and regulations. Competent professionals can contribute significantly by giving expert testimony in their fields of specialization. Without their input, judicial and administrative decisions may result in ineffective regulations. Too often, only non-scientists with good intentions offer their opinions when scientific information is needed.
>
> Most geoscientists do not feel comfortable in the public arena. Explaining a technical subject to those unfamiliar with it can be frustrating and may seem demeaning.
>
> Geoscience information is often critical in public hearings about environmental issues: legislative staff briefings and committee hearings; administrative agency hearings on regulations; and civil trials that involve such things as environmental conflicts, eminent-domain cases, personal injury and damage or value disputes.
>
> Should you be a witness? First, are you an expert? The subject on which you testify must be one in which you are an authority. Although you know more about most areas of the physical sciences than judges, juries, or legislators, you should testify only in your field of specialization. There will usually be another authority on the other side of any conflict. That person is the most critical part of your audience and will know when you are stretching beyond your expertise. Clearly, the more secure you are with your opinions, the more effective you are likely to be.
>
> Second, do you feel comfortable on your side of the conflict? In nearly all cases, you will be expected to give your opinion as an expert, and theoretically, that opinion would be the same whichever side you are on. No reputable legislator or lawyer will ask or expect you to be dishonest. If such a situation occurs, you should withdraw from the case immediately. Personal doubts will usually mean that you will not be effective, and you should decline to testify.
>
> What can an expert witness expect for ground rules? Environments in which you may give testimony have many things in common. For example, you will be talking to lawyers and to the general public. Your audience will want you to defend your opinions clearly, simply, and in detail. As a geoscientist you will serve yourself and your client best by remaining detached from any emotional conflicts and by presenting only the facts as you understand them.

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[64] James R. Dunn, CPG, "What's in Store for the Expert Witness", *Geotimes*, July 1987; pp. 11 - 12. Reprinted with permission of the author and the Editor of Geotimes.

Professional Practice in the Universities

5.31 In a paper presented by Dr. Lee C. Gerhard, CPG, to the 1983 AIPG Annual Meeting, some very pertinent advice is provided to geologists engaged in teaching activities.[65] Excerpts from the paper are repeated below.

> **All geologic academicians, whatever level, are learning, if they indeed, are professional geologists as well as being professional in education. Closed minds and dogmatism have no place in academic professionalism, although we all suffer the malady on occasion. Continued renewal of the learning process is part of the professional responsibility of the educator. Paraphrased, to educate is to learn.**
>
> **Absolute integrity of science and ethics is as crucial to the academician, student or professor, as learning itself. Without integrity of science, graduates will have little reference base upon which to model their professional standards. The ethical integrity of the faculty is the role model of the student. We do well never to forget that bond. Integrity includes the meeting of professional requirements as well, whether student coursework and field exercises or simply the proper faculty preparation for classes. Integrity means proper regard and reference to the work of others.**
>
> **Professional geologists in the academic world have an obligation to teach and defend the standards of professional behaviour. It is incumbent upon the academician to stand and be counted when these standards are challenged or denigrated; to defend highest quality and standards in education, research and student guidance. Participation in professional society and community affairs is an integral part of professional behaviour in the academic world. In this respect academicians have identical responsibilities with all geologists.**
>
> **The professional geologist must be dedicated to education and science and have considerable patience. Here are some suggestions that are both old and new, but which can serve to distinguish truly professional geologic service from that of lesser stature.**
>
> 1. **The geological professional will bring the real world into the classroom. Despite other's opinions to the contrary, I strongly encourage use of real models and data in the classroom, including the financial , legal and ethical problems of the geologic industries. We have a responsibility to the students to give them a fair appraisal of life after school. Our job includes ensuring that they have the knowledge and tools to be effective for at least five years after they leave our care, and the foundations to learn additionally during those five years so that they remain competitive for the rest of their career. Some of my colleagues from other institutions protest that the job of the university is to educate, that they are not faculty members in a 'Trade School', and other such arguments. Nonsense. Our responsibility is education, but in the world today the students have the right to expect training that will enable them to be competitive in the job market. The days of the 'Gentlemen's Degree' in geology are gone. We must face the world and our market if we are to do an**

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[65] **Dr. Lee C. Gerhard, CPGS, "Comments on Professionalism in the Academic World", *The Professional Geologist*, November 1984; pp. 6 - 8. Reprinted with permission of the author.**

effective job of education.

2. The geological professional is a professor. Professors must profess, not merely recite. Proper classroom preparation is not only a survey of the appropriate literature and text books which reflect what others have thought and interpreted, it must include what the faculty member believes, backed by the data and rationale that leads to these ideas. Be honest - if your idea is pure air, say so, but don't either hide the concept nor pretend it is data-supported. Encourage discussion of your ideas as well as those of the literature - that is why you are there. Ph.D. degrees are not necessary to recite literature. Do not back away from scientific controversy, but plunge ahead with your students, helping them to become creative by exploring and critiquing ideas - including your own. Be prepared to have your balloons burst frequently.

3. Set professional standards of excellence for yourself and your students, including participation in public affairs as a scientist. As difficult as it is to be verbally critical of others' work, it is necessary to be objective and demanding in appraising the performance of others and to expect them to be equally demanding of you. If you expect excellence, it is likely to occur. If you expect mediocrity, the best that you will receive is mediocrity. The challenge exists in all levels of work, including the challenge to graduate study and research. 'We both know that you are intellectually capable of better than this!' is one approach. It is not necessary to be blunt, in fact tact is a blessing as long as the message is clear. Lead students into excellence rather than permit the system to reward mediocrity.

Educated and productive people infused with the spirit to succeed and excel are the strength of the free world. Professionalism in geology in the academic world must produce these people, or we all ultimately fail. All of us, in academia or business, share responsibility for excellence in our field.

Chapter 6
Geological and Geophysical Societies

General

6.1 Professional associations or licensing bodies are established for the primary purpose of protecting the public. In Canada, they normally have: legal status, minimum standards for admission, codes of ethics to which their members must conform, and provisions for disciplining members who fail to practice professionally or who violate the body's ethical standards. Authority usually exists in the legislation which prohibits the practice of the profession by unauthorized individuals or entities. However, while the professional body has a definite interest in the continued technical and scientific competence of its members, its concern in these matters is mostly secondary in nature.

6.2 Most professions, besides having legal status, are organized into technical or learned societies whose basic purposes are to disseminate technical/scientific information to their members and the public. Enhancement of the competence of the members of a profession over the course of their careers is more properly the role of the society rather than the professional licensing body. As such, the requirements for membership in the society are usually much less stringent than those for admission to the professional body: ethical standards, if they exist, are not enforced, and if a form of disciplinary system is in place, the penalty is relatively minimal, usually consisting of expulsion.

6.3 With respect to the profession of engineering, according to Kemper,[66] there are over 400 engineering societies in the USA, including state and local organizations, and 21 in Canada. With respect to geology and geophysics, Geotimes, a monthly publication of the American Geological Institute, lists over 150 geological and geophysical societies in the USA, most of which are at the regional and local level, although about 20 are national organizations.[67] This same directory lists several national and regional societies in Canada connected with geology, geophysics or the earth sciences.

6.4 The main Canadian societies listed in Geotimes are:

Association of Exploration Geochemists
Canadian Exploration Geophysical Society
Canadian Geoscience Society
Canadian Geotechnical Society
Canadian Geothermal Resources Association
Canadian Society of Exploration Geophysicists
Canadian Society of Petroleum Geologists
Canadian Society of Soil Science

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[66] See footnote 12.

[67] "Directory of Geoscience Organizations", *Geotimes*, October 1989, pp. 16 - 25.

Canadian Well Logging Society
Geological Association of Canada
Mineralogical Association of Canada

Most of the above-listed societies are member societies of the Canadian Geoscience Council (see paragraph 6.18) which includes as member societies the following additional organizations:

Canadian Association of Geographers
Canadian Geophysical Union
Canadian Institute of Mining and Metallurgy
Canadian Quaternary Association
Canadian Chapter, International Association of Hydrogeologists

The two societies of direct interest to most persons in the geology and geophysics professions in Alberta - those involved in oil and gas - are the ones in italics above and these are discussed in the following paragraphs.

Canadian Society of Exploration Geophysicists (CSEG)[68]

6.5 In Alberta a society may be registered under the Societies Act which states: "five or more persons may become incorporated under this Act for any benevolent, philanthropic, charitable, provident, scientific, artistic, literary, social, educational, agricultural, sporting or other useful purpose, but not for the purpose of carrying on a trade or a business." The CSEG, organized by an enthusiastic group of geophysicists, was established under the Societies Act in 1949. Its object is to "promote the science of geophysics especially as it applies to exploration, and to promote fellowship and cooperation among those persons interested in geophysical problems." Operations of the Society were mainly to be carried on in the City of Calgary.

6.6 When the CSEG was formed in 1919 there were about 100 founding members. By 1967 it had a membership of 700, 1,000 in 1976 and at the end of 1989 there were 2,028 individual and 114 corporate members. The society operates under a set of bylaws which were adopted in 1959, later amended and formally registered by the Department of Consumer and Corporate Affairs in 1977. The bylaws cover membership, how the society is managed, meetings including technical meetings, finance, publications, committees, honours and awards, relationships with other societies including the US Society of Exploration Geophysicists (SEG). Although an autonomous group, the CSEG also operates as a section of the international SEG which, as of 1989, had about 1,550 Canadian members out of a total membership of 15,600. Of the 1,550, most are located in Alberta.

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[68] Most of the information contained in this section is based on a review of the CSEG bylaws and the CSEG Recorder.

6.7 Affairs of CSEG are managed through an Executive Committee elected annually. The society has its headquarters in Calgary. Activities are carried out by committees composed of volunteer members. Its annual budget is approximately $250,000 (1988) with revenue obtained mainly from membership dues, conventions and advertising in the monthly publication The Recorder. In addition to its technical activities, there are social activities and recreational programs which foster a spirit of comradeship among the members.

6.8 Qualifications for membership in the CSEG are broad: "Active membership may be granted to any person engaged in or interested in the geophysical profession". An application for active membership must be endorsed by three Active or Honorary Members of the Society who are personally acquainted with the applicant. A comparison of these requirements and procedures with those for registration with APEGGA illustrates the difference in roles of a professional licensing body and a technical society. With respect to ethics: "Membership in any class shall be contingent upon conformance with the established principles of professional ethics." A member who violates these principles may be suspended or expelled.

6.9 When it feels it necessary, the CSEG makes its concerns about the future of the geophysical industry known to government and the public.[69] Examples are the submission on Alleged Abuses to the Alberta Petroleum Incentive Program (APIP) made in 1983, and a letter to the federal Minister of Energy and Natural Resources about the 1986 downturn in the industry resulting from reduced oil prices.[70] But in the words of Valerie Neilsen, P. Geoph., 1983 CSEG President, the CSEG is "foremost a technical society, dedicated to the achievement of its objective". It does so through an excellent technical program consisting of:

- Publications - a monthly "Recorder" and an annual "Canadian Journal of Exploration Geophysics".
- Regular technical luncheons with talks and papers on geophysical topics.
- Annual conventions with numerous technical sessions and papers.
- Organizing and sponsoring continuing education courses and seminars.

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[69] David Finch, *Traces Through Time*, CSEG, 1985, Hignell Printing Limited, Winnipeg, pp. 132 - 133.

[70] CSEG Recorder, May 1986, p. 18.

- An honours and awards program.

- An extensive scholarship program for students at Canadian universities and institutions planning careers in exploration geophysics.

The CSEG is an excellent mechanism for its participating members to advance their technical competence in the practice of geophysics.

Canadian Society of Petroleum Geologists (CSPG)[71]

6.10 This society, formed in 1927, was originally known as the Alberta Society of Petroleum Geologists. Its purpose then was to serve the professional and scientific needs of geologists in the fledgling Western Canadian oil industry. In early 1973, the Society changed its name to the "Canadian Society of Petroleum Geologists" in recognition of the fact that it was now an organization of national scope, worldwide membership and represented petroleum geologists in most sedimentary basins in Canada. At that time, its membership had grown to just over 2,000. At the end of 1989, the CSPG had a membership of 3,800. Of this number, approximately 2,900 resided in Alberta, with the remainder located in other provinces (400), USA (400) and other countries (100).

6.11 The CSPG is registered under the Societies Act, and operates under a set of bylaws similar to those of the American Association of Petroleum Geologists, supplemented by a detailed manual of operations. While basically a technical society, its objectives cover a wider range than those of the CSEG:

1. to advance the science of geology, especially as it relates to petroleum, natural gas and other fossil fuels;

2. to promote the technology of exploration for finding and producing these resources from the earth;

3. to foster the spirit of scientific research throughout its membership;

4. to disseminate relevant information to the public at large and to government;

5. to inspire and maintain a high standard of professional conduct on the part of its members; and

6. to provide the public a means of recognition of adequately trained and professionally responsible geologists.

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[71] The CSPG bylaws and related information kindly provided by the Society was consulted in preparing this section.

6.12 Like the CSEG, the affairs and activities of the CSPG are managed and directed through an eight person Executive Committee elected annually from the membership. It is headquartered in Calgary with a full-time staff. Events and activities are organized through committees composed of over 400 Society members who volunteer their services. General income is derived primarily from membership dues, sale of publications, and conventions which in turn support its many other activities.

6.13 Qualifications for membership in the CSPG are: "Any person engaged in the work of geology or petroleum exploration or in a related research is eligible to receive an active membership, provided that he is a graduate of an institution of university standing, in which institution he has done his major work in geology or related earth science." However, these academic requirements may be waived for persons "whose standing in the profession is well recognized". With respect to ethics, the bylaws state that "each member shall be guided by the highest standards of ethics, personal honour, scientific integrity and professional conduct". Penalties for a breach of ethics are admonishment, voluntary resignation, suspension and expulsion. The bylaws also provide for a Discipline Committee which deals with violations of ethical standards.

6.14 The CSPG plays a responsible role as an active and excellent technical society through activities which include:

- Publications - a quarterly journal "The Bulletin of Canadian Petroleum Geology" and a monthly newsletter, the "Reservoir".
- Hosting of and participation in international conferences and symposia.
- Regular luncheon meetings with talks on topics and areas of scientific and exploration interest. Each meeting is attended by 500 - 1,000 geologists.
- Continuing education courses, lectures, conferences and symposia. CSPG members, the profession, and society benefit from these activities.
- Annual conventions.
- Field conferences and trips.
- An awards program.

Through membership and participation in the CSPG, every professional geologist engaged in the petroleum field can appreciably enhance his or her technical competence and professional development.

6.15 Most geologists in Alberta are involved in the petroleum industry but a significant number (10-15%) practice in other areas (mining, geotechnical, coal, environmental,

Pleistocene, teaching, government surveys.)[72] Membership in other Canadian geological societies, such as the GAC, Mineralogical Association of Canada, and others listed in paragraph 6.4 is available to these geologists.

Other Major Canadian Earth Science Societies

6.16 *Geological Association of Canada (GAC)*[73,74] Founded in 1947, the GAC's purpose is to advance the science of geology and to promote a better understanding thereof throughout Canada among both professionals and the general public. The GAC has several classes of membership for its 3,000 members including:

Fellows (majority)	-	persons holding a Bachelor's degree with a major in geology or some closely related field, and who are engaged in the practice, research or teaching of earth sciences with five years experience therein. These qualifications may be waived for persons of recognized professional standing.
Associates	-	geologists or other earth scientists in training who have the academic qualifications required for Fellow but lack experience, or other scientists who are interested directly or indirectly in the advancement of geology and other forms of earth science.

The GAS actively fosters the teaching of earth sciences in Canadian high schools and contributes to research through organizing annual and special meetings of earth scientists and publishing a wide variety of scientific papers. Its activities also include the organization and sponsorship of conferences, seminars, short courses, field trips, lecture tours and student and professional awards and grants.

6.17 *Mineralogical Association of Canada* This association was originally organized in 1954 for the purpose of sponsoring a publication devoted to mineral sciences. Its present name was adopted in 1957. The purpose of the association is to advance knowledge in crystallography, geochemistry, mineralogy, petrology and allied sciences. Any person, corporate body, or institution interested or engaged in the study or application of these sciences is eligible for membership. The association publishes a quarterly journal, "The Canadian Mineralogist", and regularly offers a number of courses on these topics which have

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[72] See footnote 40.

[73] Directory of Associations in Canada, 1988.

[74] Geoscience Canada, Quarterly GAC Journal, December 1989.

included courses in Alberta of interest to petroleum geologists.

Canadian Geoscience Council (CGC)[75]

6.18 Founded in 1972, the CGC is composed of 13 societies and associations, with six associate member groups. Its purpose is to foster close relations between earth science learned societies and professional associations in Canada, to promote earth science in the best interests of both the members of the constituent organizations and the Canadian nation. Member societies must function nationally, either as a separate organization or a formally established Canadian branch or division of a larger society.

6.19 The Canadian Geoscience Council meets four times per year. Its secretariat is at the earth sciences department of the university at which the Council's executive director is located. For most of its 17-year history this has been at the University of Waterloo. Its publications are printed by the geological survey of Canada and include an annual report. Composition of the Council is shown in figure 2.

6.20 Through its member societies, the Council represents some 15,000 earth scientists. Its founding members include both the CSPG and CSEG. The Council's professional activities include: annual reports; representations on behalf of geoscience; geoscience education; advisory committees; international geoscience; geoscience education; public forums; statements on matters of public concern; sponsoring of international workshops and symposia.

US Geological and Geophysical Societies

[75] See footnote 73.

6.21 As would be expected, there are many more technical geoscience societies in the USA than in Canada. One such organization, the American Geological Institute,[76] is a non-profit federation of 19 societies in geology and geophysics dedicated to "testing the proposition that the whole can be greater than the sum of its parts".

6.22 Many US organizations function as technical or learned societies, but the scope of others is of a wider nature as well. For example, the Society of Independent Professional Earth Scientists (SIPES) is "the only organization in the United States that is designed for the independent or consulting earth scientist. The members are geologists, geophysicists, geochemists, hydrologists, log analysts, professors, environmentalists and other earth scientists".[77]

[76] See footnote 67.

[77] Society of Independent Professional Earth Scientists, Brochure and Membership Directory, 1988-89.

Figure 1

ORGANIZATION OF THE CANADIAN GEOSCIENCE COUNCIL
(reprinted with permission)

6.23 Three of the larger US organizations of interest to geologists and geophysicists are

described in more detail in the following paragraphs.

American Association of Petroleum Geologists[78]

6.24 This US national organization, headquartered in Tulsa, Oklahoma, is stated to be the world's largest geological society, having some 40,000 members in over 90 countries:

> AAPG was formed in 1917 to foster the spirit of scientific research among its members and to advance the science of geology - particularly as it relates to petroleum and energy minerals.
>
> To achieve these goals, AAPG publishes the "Bulletin", a monthly geologic science journal, the "Explorer" monthly newspaper, and "Geobyte" - a quarterly computer magazine; sponsors continuing education schools, seminars and field trips; holds conventions; publishes special geologic books and materials; and provides geologic information to the general public.
>
> The membership ranges from undergraduate college students to independent oilmen and chairmen of the boards of major corporations.

6.25 The AAPG is incorporated under the laws of the State of Colorado. Membership consists of "persons concerned with the professional applications of the geological science"; admission to active membership requires a Bachelor's degree in geological science from a college of acceptable academic standards and three years of experience in the practice or teaching of geology. The degree requirement may be waived on the basis of adequate professional experience and standing.

6.26 The AAPG constitution contains a comprehensive code of ethics and provides for disciplinary measures against members who violate the code. Penalties for AAPG members whose charges of misconduct are found to be sustained consist of admonishment, suspension, permitted resignation or expulsion. The bylaws also provide for establishment of a technical division (of AAPG) to conduct a program of voluntary certification of members. A Division of Professional Affairs was set up to implement such a program for petroleum geologists and to improve professional well-being of AAPG members. This division issues a certificate for the certified petroleum geologists.

Society of Exploration Geophysicists (SEG)[79]

6.27 The SEG is basically a scientific and educational society that has served exploration for more than 50 years. It has a membership of over 19,000. Its objectives are "to promote the science of geophysics, especially as it relates to exploration and research, to foster the common scientific interests of geophysicists and to maintain a high professional standing among its members". Through its scientific journal "Geophysics", and its monthly

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[78] American Association of Petroleum Geologists, Constitution and Bylaws and other information provided by AAPG, October 1989.

[79] See footnote 18.

"Geophysics: The Leading Edge of Exploration", the SEG supplies a medium for the dissemination of new knowledge for the profession.

6.28 The SEG is governed under a constitution and set of bylaws, which include a code of ethics. Penalties for clear violations of the Society's code of ethics, for any action critically disruptive of SEG goals and purposes, or for serious misconduct or dishonesty are suspension or expulsion, as determined by the SEG Executive Committee.

6.29 To be eligible for active membership in the SEG, a person "must be actively engaged in practising or teaching geophysics or a related scientific field. The applicant's work must have been of a professional nature for not less than eight years and must have been of a responsible nature calling for exercise of independent judgement and the application of geological and geophysical principles during at least three years of the total eight years professional experience".

6.30 APEGGA members Norman J. Christie, P. Geoph. and Roy O. Lindseth, P. Geoph. served as President of the SEG during 1963-64 and 1976-77 respectively.

American Institute of Professional Geologists (AIPG)

6.31 The AIPG is more than just a technical society. Its purposes include: "To advance the geological sciences and profession of geology"; "To promote high standards of ethical conduct among its members and within the profession of geology".[80] The Institute is dedicated to communicating to the public and to its representatives the importance to society of the profession.

6.32 One of the AIPG's major activities is certification of members:[81]

> Certification is an activity that provides a service to the public. Applicants for AIPG membership undergo a peer review process in which each applicant's educational credentials are verified and a record of at least five years of professional experience is reviewed. Only applicants with satisfactory educations and records of practice that document performance in accord with high standards of technical competence and personal integrity are admitted as members of the Institute. These members receive the title "Certified Professional Geologist" (CPG). When the letters "CPG" follow an individual's name, they proclaim to the public that the individual has voluntarily allowed his/her qualifications to be formally judged by peers and has been found by peers to be worthy of public trust in the practice of geology.

6.33 Representation, information and education are other major activities of the AIPG. The interests of geology as both a science and a profession are represented at the public and federal levels. AIPG expedites the transfer of information that affects the profession of geology. Information is provided to members, educators and government officials through the

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[80] AIPG *Bylaws, as amended*, December 11, 1989.

[81] APIG *1989 Membership Directory*. Quoted with permission.

monthly publication "The Professional Geologist" and the Annual Membership Directory, and to the general public through "Issues and Answers" booklets. Education is provided for its members through seminars, short courses, sectional and national meetings and publications. Educational assistance is also provided to high schools, colleges and universities.

6.34 A voluntary individual membership association, the AIPG has more than 4,700 members in the US and abroad. The 1989 directory listed 27 members in Canada, 14 of which were in Alberta. Qualifications for membership as a CPG are a university degree in geology, geophysics, geochemistry, geological engineering or their sub-divisions, five years of experience and high standards of professional integrity and ethics. Applications screening and approval procedures are quite rigorous. The organization has a distinctive code of ethics. (See appendix E). The bylaws provide for the Executive Committee of the Institute to exercise disciplinary procedures against members who violate the provisions of the Code of Ethics. Penalties include admonition and reprimand, suspension and membership termination. The AIPG's disciplinary procedures are extensive.

Positions of American Organizations Respecting Registration

6.35 Like some members of the CSPG and CSEG, the three organizations just described have tended to oppose the introduction by US states of the licensing (by government) of geologists and geophysicists. But, like early developments in the CSEG and CSPG, there were opinions on both sides of the issue.

6.36 The Society of Exploration Geophysicists, according to its President 87-88 in an address to the Annual Meeting, had the following position:[82] "For the record, the SEG over the past years has been against any effort to register and/or certify geophysicists, taking the position that rules of this type would tend to restrict the ability of a geophysicist to practice his profession."

6.37 The Division of Profession Affairs (DPA) of the American Association of Petroleum Geologists was established to conduct the program of voluntary member certification. The DPA established a committee on state licensing in 1987, specifically with reference to petroleum geologists, because it seemed that the freedom of petroleum geologists to practice their profession as and where they chose may be in jeopardy. According to a report of this committee,[83] the AAPG Executive Committee resolved that "the AAPG officially opposes state registration legislation which could negate or restrict the normal practice of petroleum geology by qualified geologists who are either residents or non-residents of the state involved." This opposition does not apply to geologists other than petroleum geologists, where public safety and health are an issue.

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[82] L.C. Lawyer, Address to SEG International Meeting, *Geophysics: The Leading Edge of Exploration*, March 1989.

[83] G. Warfield Hobbs IV, A Report from the DPA, *AAPG Explorer*, May 1988.

6.38 The American Institute of Professional Geologists (AIPG) has peer certification as one of its main activities, and it too has tended not to favour registration. To quote from some very informative comments by the AIPG Executive Director:[84]

> Now, before some of you get all stirred up about the pros and cons of registration, let me make AIPG's position very clear. What we practice and really favour, very strongly, is peer certification as a Certified Professional Geologist to be recognized by the States as equivalent to registration. Obviously, this has not occurred in most jurisdictions. There are conditions under which geologists in a state become convinced that registration in their state is necessary and they take steps to bring it about. Then, we strongly encourage them to involve members from across the entire spectrum of our profession. And, we try to give them as much help as we can to assure that any law written will be one with which all professional geologists can live. Our participation in this process should not be misinterpreted as our favouring registration per se.

6.39 The AIPG in October 1989 adopted a specific policy on registration which is discussed in the next chapter (paragraphs 7.22 - 23).

6.40 The report from the DPA described in paragraph 6.35 generated a number of comments from readers that were published in a later issue. The following excerpt from one of these letters about the enhancement or otherwise of geologic work or ethics is interesting:[85] "This is, I admit, a difficult question. I can only suggest that the sword of a registration board hanging over one's head has a strong and positive influence on quality of work due to the power behind it. It is important to note that the mere existence of the power and the sword encourage good performance. Geologists are intelligent people, and the power need not be exercised broadly for them to get the message."

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[84] William V. Knight, Executive Director, "Standing ... Independence ... Freedom", *The Professional Geologist*, July 1989, p. 1. Quoted with permission.

[85] "Forum", *AAPG Explorer*, August 1988, p. 29.

Chapter 7
Certification and Registration of Geologists and Geophysicists in the USA

Engineering Registration

7.1 Registration of the professions in the United States experienced a slow and sluggish start, beginning with dentists in 1883. The first registration law governing the practice of engineering (and land surveying) was passed in 1907 (Wyoming). Other states followed suit in a slow but steady procession.[86]

7.2 The authority to regulate the practice of a profession in the United States is a right reserved to the states pursuant to the Tenth Amendment to the Constitution relating to the police powers of the state. Today, all 50 states and the five jurisdictions - District of Columbia, Puerto Rico, Guam, Virgin Islands and North Marianas Islands have laws regulating the practice of engineering and/or land surveying. Each state board responsible for professional licensing operates within the framework of individual state laws. For engineering, considerable progress has been made over several decades in promoting uniformity of standards by the national organization - the National Council of Engineering Examiners (whose name was changed in 1989 to the National Council of Examiners for Engineering and Surveying (NCEES)). The NCEES developed and maintains a Model Law as a basis for registration in individual states.

Geologists and Geophysicists

7.3 Registration of geologists and geophysicists in the USA has lagged well behind engineers and does not appear to have begun until the late 1960s and 1970s. In 1984 there were ten states which registered or certified geologists - Alaska, Arizona, California, Delaware, Georgia, Idaho, Indiana, Maine, Oregon and Virginia. North Carolina introduced legislation in 1984 to be effective January 1, 1985. By December 1989 four additional states - Arkansas, Florida, South Carolina and Tennessee - had introduced legislation, increasing the number to 15. Others currently have laws in preparation. Three states have a statutory definition for geologists - Colorado, Kansas and Missouri. Only California registers geophysicists.

7.4 Although most of the US states "register" geologists, there are four that "certify" geologists - Alaska, Indiana, Maine and Virginia. "Registration" is a legally established process that: has a definitive set of qualifications that are needed to practice, has established codes of professional conduct, has disciplinary procedures in place with penalties for members who fail to practice professionally, and has regulations which prohibit practice by unauthorized persons. "Certification", on the other hand, generally consists of

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[86] "The Registration of Professional Engineers and Land Surveyors in the United States", NCEE Bulletin, 1978, verified with NCEES December 1989.

the process of examining the qualifications of geologists relative to certain academic and other standards, and certifying the competence of individuals who satisfy these standards.

7.5 There appear, however, to be slightly varying degrees of certification among the four state boards which have certification legislation. Indiana's certification program, for example, is "designed entirely to establish professional competence in geology". Indiana and Maine require geological documents to be sealed by certified geologists; Virginia's legislation in that regard is permissive.

7.6 Up to 1989 there has not been a US national organization similar to NCEES (or the CCPE in Canada) for engineers, which promotes country-wide universal and common registration standards for geologists. In 1989 representatives of southeastern US state boards held a number of meetings to discuss matters of mutual interest. This group has adopted the title "Association of State Boards of Geology" and is preparing a charter and bylaws.[87]

7.7 Registration and certification requirements vary from state to state in some cases, and in others the legislation is similar. The major parameters for the 15 states are summarized in Table 1. More detailed information for California, and for Georgia and Indiana, as examples of states which register and certify geologists, is given in paragraphs 7.8 through 7.17.[88]

The California Geologists and Geophysicists Act

7.8 A discussion of registration of geologists and geophysicists in California is appropriate because, like Alberta, it is a jurisdiction which regulates the practice of both the professions of geology and geophysics.[89]

7.9 An article by Henry H. Neel, Past National President of the California Section,

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[87] AIPG *The Professional Geologist, July 1989* and December 1989.

[88] These summaries were derived from the various state legislation as kindly provided by the individual State Boards.

[89] Paragraphs 7.7 - 7.13 are based on a review of the California Act with amendments through 1987, accompanying regulations with amendments through 1988, and the California State Board Newsletter, December 1983 and spring 1988, as authorized by J. Wolfe, Executive Secretary.

Association of Professional Geological Scientists. "History of the Registration of Geologists in California" is repeated in Appendix G, and provides informative background on how the regulation process evolved. The California Act was enacted in 1968. It began with geologists only; in the early 1960s, the Board approached the geophysicists who initially rejected the concept of legal registration on the grounds of their work being strictly "technical". However, registration was permitted as "Registered Geologists". This satisfied some geophysicists, but not those who had education in mathematics, physics and other disciplines related to geophysics. Therefore in 1972, the Act was amended to include registration of geophysicists.

7.10 According to the California State Board newsletter December 1983, the purpose of any occupational licensing law is to protect the citizens of the state, and this was very appropriately stated in the first paragraph of the original bill (AB 600) that was signed into law by Governor Reagan in 1968. The paragraph reads:

> This chapter is enacted in order to introduce qualifying criteria in a presently unregulated professional field. Such action recommends itself through benefits to the safety, health and property of the people of the State of California and to the promotion of the public welfare. These benefits are in the fields of geology as related to engineering, groundwater, mineral exploration and development, geologic hazards, the further development of the science of geology, and other geologic matters of concern to the people of the State.

7.11 The legislature delegated authority to the Board to administer the Geologist and Geophysicist Act (Chapter 12.5 of the Business and Professions Code of California). It has been given specific authority to regulate the geology and geophysics professions by licensing qualified applicants, disciplining licensees who violate the Act, investigating and aiding in the prosecution of unlicensed practice, and establishing regulations to implement, interpret, and make clear the Act. In taking the lead on licensing, it also works toward establishing relations with other states for the purpose of working towards uniformly high professional standards and mutual recognition of registration.

7.12 The California Act provides for the registration of geologists and geophysicists as "Registered Geologists" and "Registered Geophysicists", and also for certification in specialty areas for which the designation is "Registered Certified Specialty Geologist (or Geophysicist)". In 1984 there was only one designated specialty, that of Engineering Geology. The Act, and accompanying Rules and Regulations, also contain specific and detailed definitions of geology, geophysics; the practices of geology and geophysics; professional work and responsible charge. It provides an exemption for geologists and geophysicists who do not practice geology and geophysics "for others" ("for others" meaning the public) - such persons may call themselves geologists and geophysicists but are not required to be registered.

Qualifications for Registration

7.13 These are basically:

1. **Not have committed acts or crimes constituting grounds for denial of license under a section of another Act.**

2. **Education - must meet certain educational requirements fulfilled at a school or university whose curricula meet criteria established by rules of the Board.**

3. **At least 7 years of professional experience, including either 3 years under supervision or 5 years in responsible charge, of which undergraduate study, teaching, graduate work can count towards experience.**

4. **Pass a written examination (may be waived if the individual is the holder of an equivalent certificate of registration in another state or country.)**

7.14 The State Board of Registration, which administers the Act, consists of three professional and five public members appointed by the Governor of California, the Senate Rules Committee and the Speaker of the Assembly, for four-year terms. Two geologists and one geophysicist comprise the professional members. The Board is primarily a licensing body, and does not offer membership and communications services. This mode of operation and terms of reference are typical of the engineering and geologist registration boards in the USA. There are four standing committees listed in the Act - legislative Committee, Executive Committee, Professional Affairs Committee and Examination Committee. The Professional Affairs Committee (or Professional Practice Committee) serves as a fact-finding and reviewing committee for the Board to develop guidelines for professional practice and to propose regulations which pertain to professional practice.

7.15 A summary of some of the other provisions of the California Act are given below:

Exemptions: **Federal officers and employers practising solely as such, geologists and geophysicists subordinate to a registered geologist/geophysicist, and civil and petroleum engineers practising in their field are exempt from registration. A corporate entity whose principal business is other than geology or geophysics is not prohibited from employing a geologist or geophysicist to perform professional services incidental to its business.**

Signing and Sealing: All geological and geophysical plans, specifications, reports or documents shall be prepared, signed and sealed by a registered geologist, registered geophysicist, or registered certified speciality geophysicist/geologist. Design of the seal is specified in the Rules and Regulations.

Discipline: The Board has authority and acts on disciplinary matters where the following violations are alleged to have occurred: conviction of a crime substantially related to the practice of a geologist and geophysicist: unskilled practice, incompetency, misrepresentation, fraud, and negligence: violating the Act: aiding and abetting violation of the Act. However, the penalties are limited to reproval, revocation or suspension.

Code of Ethics: Unlike some of the other states which register geologists, California does not have a code of ethics or of professional conduct specified in its legislation.

Temporary Authorization: Provision is made for the practice of geology, geophysics or the specialties for a specific project for a limited period.

Prohibitions and Penalties: Eight specific offenses related to and unlawful practice of geology and geophysics and other areas are listed. These misdemeanours are each punishable by a fine of up to $1,000, imprisonment of up to 3 months or both fine and imprisonment. Injunctions against illegal practice may be issued by the superior court.

Corporate Practice: The Act does not prohibit one or more geologists or geophysicists from practising under a sole proprietorship, partnership or corporation, but if the primary activity consists of geological or geophysical services, at least one partner or officer shall be registered.

7.16 *Example of State Registration Requirements - Georgia*

Governing legislation: Registration of Geologists Act of 1975, amended to 1987, Chapter 19 of Professions and Businesses Code, and Rules of Board amended to 1983.

Administered by: Georgia State Board of Registration for Professional Geologists. Operates under the detailed set of rules set out in legislation. Consists of 5 geologists each from specified employment sectors and one public member, all appointed by state, and the Commissioner of Natural Resources or his designated agent as permanent ex-

officio member. Attorney-General of State or designate acts as Board's legal advisor.

Purpose: "In order to safeguard life, health and property and to promote the public welfare, the practice of geology in this state is declared to be subject to regulation in the public interest. This chapter is intended to introduce qualifying criteria in a previously unregulated professional field. Such action recommends itself through benefits to the safety, health and property of the people of this state and to the promotion of the public welfare. These benefits are in the fields of geology as related to engineering, groundwater, mineral exploration and development, geologic hazards, the further development of the science of geology and other geologic matters of concern to the people of the state." (Act 43-19-2)

Definitions: The Act defines "Geologist": "Geology" - makes reference to benefit to mankind; "Public practice of geology": "Qualified geologist" - one who is qualified for registration but not registered; "Registered geologist"; "Registered certified specialty geologist"; "Responsible charge of work" and "Subordinate".

Exemptions: Teaching (solely) the science of geology, non-public geologic research, federal or state employees, subordinate geologists.

Title: Registered geologist; Registered certified specialty geologist.

Qualifications for Registration:

Education: Degree from accredited college or university approved by the Board, or equivalent academic courses.

Experience:

1. 7 years of professional geological work, including at least 3 under supervision or at least 5 in responsible charge.
2. Education and experience combined may count towards the 7 years.
3. Ability demonstrated by having performed responsible work to satisfaction of Board.

Examinations.

Good ethical character.

Registered geologists are eligible for certification in a specialty:

must meet specified experience requirements. Examinations may be waived.

Certificates and Seals: Certificates are issued on registration and renewed biennially. Drawings, reports or other geologic papers or documents involving the practice of geology shall be sealed with the seal of the registrant or specialist. Seal design authorized by the Board.

Code of Ethics: A code of professional conduct is set out in State Board Rules. Ten articles, quite similar to APEGGA's pre-1987 code of ethics.

Discipline: Board is empowered to discipline registrants who registered fraudulently, were involved in gross negligence, incompetence or misconduct, any felony or crime involving moral turpitude, the commission of any unlawful act as set forth in the Geologist's Act. Penalties - suspension, revocation or non-renewal of certificates.

Prohibitions: Practice or offering to practice geology publicly for others by non-registered persons, use of another's seal, false evidence for registration, impersonation of registrant, practice while under suspension. These constitute misdemeanours.

Corporate Practice: Practice as sole proprietorship, partnership or corporation is permitted; at least one partner or officer must be registered. Non-registered geologists may perform non-public geological services (in-house) for firms whose principal business is other than public practice of geology.

General: The State of Georgia and its political subdivisions are required to contract for geological services only with registered geologists or firms employing registered geologists.

7.17 *Example of State Certification Requirements - Indiana*

Governing legislation: Certification of Geologists Regulations No. 1, (310 IAC 9-2). Adopted by Resolution of Natural Resources Commission, Indiana Department of Natural Resources December 1979.

Administered by: Geological Survey, Department of Natural Resources, Bloomington, Indiana. Certification Panel consists of State Geologist plus 6 other geologists.

Definitions: Defines "Certified professional geologist", "Geology", "Qualified Geologist", "Responsible position", and "Professional geological work".

Exemptions: None listed.

Title: Certified professional geologist.

Qualifications for Certification: Certification by AIPG or the following:

Education: Degree from accredited institution or equivalent academic courses.

Experience:

1. 7 years of professional geological work, including at least 3 years under supervision of a certified professional geologist, or at least 5 years in responsible position.
2. Education, teaching and experience may be combined to count towards the experience requirement.

Good moral character.

Certificates and Seals: Issued on certification. Design of seal specified in regulation and is inscribed with the words "Certified professional geologist, State of Indiana" and certificate number. Sealing of documents not a requirement of the regulation, but sealing by non-certified individuals is prohibited.

Code of Ethics: None.

Discipline: No disciplinary provisions, but conviction of felony or crime involving moral turpitude is treated as a conviction under the regulation and may lead to suspension or revocation.

Prohibitions: None.

(Narrative continued on page 95)

Table 1. Summary of State Board Requirements

	California (1968)	Idaho (1971)
Governing legislation	Geologist and Geophysicists Act of Business and Professions Code, 1968; amended 1972 to include geophysicists.	Act relating to Professional Geologists 1971, supplemented by By-laws and Rules of Procedure.
Administered by	State Board of Registration: Sacramento. 3 professional and 5 public members.	Idaho State Board of Registration for Professional Geologists: Boise. 10 geologists.
Purpose	To introduce qualifying criteria in a previously unregulated professional field and to benefit safety, health and property of people of state and promote public welfare.	To safeguard life, health and property and to promote public welfare.
Title or designation	Registered Geologist/Geophysicist; Registered Certified Geologist/Geophysicist.	Professional Geologist.
Qualifications required		
Education	Education at school or university whose curricula meet criteria established by Board.	Degree in geological sciences with minimum academic credits.
Experience (figures in brackets are years under supervision, in responsible charge)	7 years (3 and 5). Undergraduate and graduate study, teaching can count.	7 years (3 or 5). Education and experience combined can count.
Other	Written exam (may be waived if registered in another state or country).	Exams as specified by Board. No habits of character to justify suspension or revokation.
Code of Ethics	None.	Yes; preamble relating to geological profession and 8 articles.
Disciplinary Provisions	For crimes relating to practice; unskilled practice, incompetency, fraud, negligence; violating the act or aiding violation. Penalties-reproval, revokation or suspension.	For fraudulent registration, gross negligence, incompetence or misconduct, crimes involving moral turpitude. Penalties-suspension, revokation or non-renewal.
Remarks	California is the only state which also registers geophysicists.	

Table 1. - continued

	Delaware (1972)	Maine (1973)
Governing legislation	Delaware Geologists Registration Act 1972, revised 1978 and 1987.	Geologists and Soil Scientists Certification Act, 1973, amended to 1987.
Administered by	State Board of Registration of Geologists, Department of Administrative Services, Division of Business and Occupational Regulation: Wilmington, 3 professional and 2 public members.	State Board of Certification for Geologists and Soil Scientists, Department of Professional and Financial Regulation: Augusta, 3 geologists, 3 soil scientists and 1 public member.
Purpose	None stated.	None stated.
Title or designation	Geologist	Certified Geologist.
Qualifications required		Examination required for certification: qualifications needed to write are:
Education	Degree from accredited college or university or minimum academic credits.	Degree or completion of credits from accredited college or university, or 7 years of professional geological work.
Experience (figures in brackets are years under supervision, in responsible charge)	5 years (-, 3).	7 years in responsible charge: degrees count up to 2 years.
Other	Must possess experience, competency and integrity satisfactory to Board.	Must be of high ethical standards.
Code of Ethics	Yes: 26 articles.	Yes, 27 articles: general principles: relations of geologists and soil scientists to public, employer and each other: duty to professions.
Disciplinary Provisions	For violations of Act and regulations including code of ethics. Penalties-suspension or revokation.	For fraudulent certification, gross negligence, incompetence or misconduct, felonies/crimes affecting ethical standards, violation of Act. Penalties - suspension, revokation or non-renewal.
Remarks	Delaware Board has a memo of understanding with the State Association of Professional Engineers regarding jurisdictional concerns that may arise.	No one may practice without certification, unless specifically exempted.

Table 1. - continued

	Georgia (1975)	Oregon (1977)
Governing legislation	Registration of Geologists Act 1975 amended to 1987, and Rules of Board amended to 1983.	Geologists ORS 1977.
Administered by	Georgia State Board of Registration for Professional Geologists, Department of Natural Resources, Atlanta, 5 geologists, 1 public member, and Commissioner of Natural Resources or designate.	State Board of Geologist Examiners, Department of Commerce, Salem, 4 geologists and 1 public member.
Purpose	To safeguard life, health and property and to promote the public welfare.	To introduce qualifying criteria in unregulated professional field; to safeguard life, health and property and to promote public welfare.
Title or designation	Registered geologist, registered certified specialty geologist.	Registered geologist, registered certified specialty geologist.
Qualifications required		
Education	Degree from accredited college or university approved by Board, or equivalent academic courses.	Degree from accredited college or university or equivalent academic courses.
Experience (figures in brackets are years under supervision, in responsible charge)	7 years (3 or 5). Education and experience combined can count.	7 years (3 or 5). Education and experience combined can count.
Other	Examinations. Good ethical character.	Examinations.
Code of Ethics	Yes: code of professional conduct in State Board Rules. 10 articles.	Yes: Code of Professional Conduct in Administrative Rules. 16 rules covering competence, conflict of interest, full disclosures, compliance with laws, professional conduct.
Disciplinary Provisions	For fraudulent registration, gross negligence, incompetence or misconduct, felonies/crimes involving moral turpitude, violations of Act. Penalties - suspension, revokation or non-renewal.	Same as Georgia.
Remarks		

Table 1. - continued

	Indiana (1979)	Alaska (1980)
Governing legislation	Certification of Geologists Regulation No. 1, Department of Natural Resources 1979.	legislation enacted in 1980 provides for certification of geologists if certified by AIPG.
Administered by	Geological Survey, Department of Natural Resources, Bloomington. Certification panel consisting of State Geologist plus 6 geologists.	Department of Commerce and Economic Development, Division of Occupational licensing, Juneau.
Purpose		
Title or designation	Certified professional geologist.	Professional geologist.
Qualifications required		
Education	Degree from accredited institution or equivalent academic courses.	Degree from a accredited institution or demonstration of sound knowledge and proficiency equivalent to M.Sc.
Experience (figures in brackets are years under supervision, in responsible charge)	7 years (3 or 5). Education, teaching, and experience can count.	5 years: 1 year for M.Sc., 2 years for Ph.D. but maximum credit 2 years.
Other		
Code of Ethics	None.	None.
Disciplinary Provisions	None, but conviction of a felony or crime involving moral turpitude is violation of regulation and may lead to suspension or revokation.	None.
Remarks	Must be certified to stamp documents or use title. Certification by APIG is acceptable in lieu of qualifications stated above.	

Table 1. - continued

	Arizonia (1983)	Virginia (1984)
Governing legislation	Arizonia Revised Statutes 1983 amended to 1987 and rules of State Board 1983.	Code of Virginia. Geologists 1984 amended to 1987.
Administered by	State Board of Technical Registration for Architects, Assayers, Engineers, Geologists, landscape Architects and Land Surveyors. Phoenix. 8 professional members and 1 public member.	Virginia Board of Geology. Department of Commerce. Richmond. 3 geologists and 2 public members.
Purpose	To provide for safety, health and welfare of public through promulgation and enforcement of standards of qualification.	To safeguard life, health, property and the environment and to identify qualified individuals.
Title or designation	Registered Geologist, etc.	Virginia certified professional geologist.
Qualifications required		
Education	8 years education or experience or both.	Degree from accredited college or university or equivalent academic courses.
Experience (figures in brackets are years under supervision, in responsible charge)	see above.	7 years (3 or 3). Education and experience can count.
Other	In-Training and professional examinations. Good moral character and repute.	Examination. Good ethical character.
Code of Ethics	Yes: 15 rules of Professional Conduct set out in Rules of State Board.	Yes: 16 articles in Rules under Standards of Practice and Conduct.
Disciplinary Provisions	For fraudulent registration, gross negligence, incompetence, bribery or other misconduct in practice; violation of rules or regulations; aiding or abetting non-registered persons to violate the legislation. Penalties - censure, probation, up to $2000 civil penalty, suspension or revokation.	For fraudulent certification; violation of Standards of Practice and Conduct or regulations; gross negligence, incompetence or misconduct; felony. Penalties - suspension, revokation or non-renewal.
Remarks	Rules are very comprehensive.	Certification is a voluntary procedure.

Table 1. - continued

	North Carolina (1985)	South Carolina (1986)
Governing legislation	Geologists licensing Act 1985 amended to 1989 and Rules. Board of Geologists 1989.	Amendment to Code of laws of South Carolina, adding Chapter 77, 1986; supplemented by Rules of Board, 1986.
Administered by	North Carolina Board for licensing of Geologists. Raleigh. 4 geologists, 1 public member; State Geologist is ex-officio.	State Board of Registration for Geologists. Columbia. 4 professional and 2 public members.
Purpose	To protect life, property, health and public welfare; to define the practice of geology as a profession, establish minimum professional standards, prevent abuses of practice by untrained or unprincipled individuals.	To safeguard life, health and property, and to promote public welfare; the public practice of geology in South Carolina declared subject to regulation in the public interest.
Title or designation	licensed geologist.	Registered professional geologist. (Also recognition in a specialty may be granted)
Qualifications required		
Education	Degree from accredited college or university or equivalent academic courses.	Graduation in (a) geologic or (b) geology or related science curriculum, of 4 or more years approved by Board.
Experience (figures in brackets are years under supervision, in responsible charge)	5 years (3 or 3). Education and experience combined can count.	5 years, if (a) above; 8 years if (b) above. If recognized in a specialty, 3 years under supervision or 4 years in responsible charge.
Other	Examination. Good moral and ethical character.	Examination
Code of Ethics	Yes; Code of Professional Conduct, 27 rules.	Yes; Code of Professional Ethics set out in Rules. 10 specific articles.
Disciplinary Provisions	For violation of Act or Rules, misdemeanour or felony, gross unprofessional conduct, dishonest practice, fraudulently obtaining license or assisting obtaining by others. Penalties - suspension, revokation or non-renewal.	For insanity, or for; fraudulent registration; gross negligence, incompetence or misconduct; crime involving moral turpitude, violating or aiding/abetting violations of Chapter 77. Penalty - revokation.
Remarks		

Table 1. - continued

	Florida (1987)	Arkansas (1987)
Governing legislation	Florida Statues. Professional Geology 1987 and Board Rules 1988.	Registration of Geologists Act. 1987.
Administered by	Board of Professional Geologists. Department of Professional Regulation. Talahasee. 6 professional geologists and 2 public members. and ex-officio.	State Board of Registration for Professional Geologists. c/o Arkansas Geological Commission. little Rock.
Purpose	To safeguard life. health. property and public well-being of citizens.	
Title or designation	Professional geologist (licensed).	Registered geologist. registered certified specialty geologist.
Qualifications required		
Education	Graduation from college or university in geology or other related science with curricula accredited by agency recognized by US Department of Education. (see remarks)	Graduation from accredited college or university approved by Board.
Experience (figures in brackets are years under supervision. in responsible charge)	7 years (3 or 5).	7 years (3 or 5). Education and experience can count.
Other	Examination: must satisfy above criteria to be eligible to write. No offense that would constitute the basis for disciplining.	Examinations. Good ethical character.
Code of Ethics	None.	Act provides for Board to prepare and adopt a code of professional conduct.
Disciplinary Provisions	For 11 acts listed in statute. Penalties - denial of application. revokation or suspension. fine. reprimand. probation. restriction of practice.	For fraudulent or deceitful registration. gross negligence. incompetence. or misconduct. felony. unlawful acts setforth in Act.
Remarks	Board maintains a list of approved degree programs of schools and colleges.	

Table 1. - continued

	Tennesee (1989)
Governing legislation	An Act Relative to Geology. Senate Bill 1473. January 1. 1989.
Administered by	Department of Commerce and Insurance. Division of Regulatory Boards. Geology Section. Nashville.
Purpose	
Title or designation	Professional Geologist.
Qualifications required	Not stated specifically: can infer from definitions:
Education	Graduate of accredited institution of higher education in geology or geological engineering (a "geologist").
Experience (figures in brackets are years under supervision. in responsible charge)	5 years plus sustained record of exemplary professional and ethical conduct (Professional Geologist).
Other	
Code of Ethics	None.
Disciplinary Provisions	Not specified.
Remarks	

(Narrative continued from page 86)

Summary of State Legislation

7.18 Table 1 is a summary of the requirements of the 15 American states which register or certify geologists. In all cases the state boards have been established as government agencies, either as individual entities or part of a department. The state government appoints the board members which include public members. This is the major difference between registration/certification processes in the USA and those of the self-governing professions in Canada. For those states which have a defined "purpose" in their legislation, the words invariably are to "protect life, property, health and the public welfare" or some variation of this phrase.

7.19 As to academic requirements for registration, most states require graduation with a four-year bachelor's degree from an accredited institution, although one or two require graduation from a "program" that is accredited or acceptable to the board. For eight states, the experience requirement is seven years; others require five years. Periods of the required experience include time under supervision and in responsible charge. Credit is usually given for education, higher degrees and teaching. For 11 states, examinations are required.

7.20 Eleven states have codes of ethics embodied in their legislation. With three exceptions, all states have disciplinary procedures in place - the exceptions being Indiana and Alaska which certify geologists, and Tennessee. Although not included in the parameters listed in Table 1, legislation of most of the states includes regulations about practice prohibitions and corporate practice.

7.21 Table 1 was prepared from a review of the legislation obtained from the various state boards. For further details, the individual state boards or agencies should be consulted.

American Institute of Professional Geologists Registration Position

7.22 The AIPG has tended to generally oppose individual state registration and licensing. As in most geological and geophysical organizations, the pros and cons of registration received a good deal of attention over the years.

7.23 The Executive Committee of the AIPG adopted the following new policy regarding state registration and licensing on October 6, 1989:[90]

> **AIPG believes that its certification of professionals by their peers as to their competence and ethical behaviour is to be preferred as the most effective available means to protect the public health, safety and welfare. Self-regulation is the most desirable form of certification and regulation of professional practice.**

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[90] **AIPG, *The Professional Geologist*, December 1989, p. 2. Quoted with permission.**

However, AIPG recognizes that there are jurisdictions in which self-regulation provides no legal standing, thus adversely affecting the geologists' ability to practice their profession to effectively protect public health, safety, and welfare. If the Certified Professional Geologists in such a jurisdiction find that the protection of the public health, safety, and welfare requires the statutory regulation of geologists, AIPG will support efforts to assure sound and reasonable statutory regulation appropriate to the conditions of that jurisdiction.

As the national organization of professional geologists, AIPG recognizes the need for and advocates uniformity of standards so that the mobility of geologists will not be impeded, and so that their varied skills may be available throughout the nation.