

Opportunities in the Earth Sciences: Making Connections Between the Earth and Its People

“There is but one ocean though its coves have many names; a single sea of atmosphere with no coves at all; the miracle of soil, alive and giving life, lying thin on the earth, for which there is no spare.”

David R. Brower (1912 - 2002)

My work as a research scientist with the Geological Survey of Canada (established in 1842, Canada’s oldest scientific body) has taken to many remote parts of Canada and elsewhere in the world. I have had a wonderful opportunity to get a good view of this magnificent blue planet we call home. In my travels, I have become aware that many of Earth’s inhabitants do not have a very full understanding of their relationship to the Earth. This lack of understanding of the relationship of the Earth and its people is most acutely evident in first world, urbanized countries like Canada. People living in poorer economies live in much closer connection to the Earth and so have a much better understanding of their immediate relationship to the Earth but lack the education or global experience to understand the larger issues, such as population growth or global warming.

I sense that people lack an appreciation of the Earth in two main areas: 1, understanding how Earth’s resources are connected to our civilization and 2, understanding the earth processes that must be taken into consideration in order to have sustainable development. I feel privileged to be an earth scientist because, as a group, we hold the key to improving the level of understanding and plugging people back into the Earth.

Earth scientists work in many areas: seeking out earth resources for potential use, providing recommendations for appropriate environmental management, and studying earth processes such as plate tectonics, ocean circulation and atmospheric patterns. We look at the earth from inside to outside and comparing our planet to its place in the solar system.

OPPORTUNITIES IN THE RESOURCE INDUSTRIES

Most Canadians no longer make the connection between the exploration, development and consumption of Earth resources and their personal comfort and wellbeing.

In fact, we now face a situation where most decision makers think of natural resources as a thing of the past, inherently dirty and inefficient, and perhaps more in tune with the industrial revolution of the nineteenth century. They believe the twentieth century represented the transition from that dirty, resource-consuming, industrial age to the brand new, globally connected, technologically advanced, information age. The twenty-first century, they think, is to be characterized by this clean and efficient information age. They fail to connect our current level of civilization and technological sophistication to the Earth resources necessary for their construction.

In economic terms, this is expressed in terms of the “New Economy”. The new economy comprises such things as hardware and software,

business services, pharmaceuticals, entertainment, communications, and pipelines. These are regarded as clean and knowledge intensive, requiring people with high skills. Then, according to these pundits, there is the old economy that includes mining, oil and gas, paper and forest products, steel, building materials and food processing: industries related to primary resources and needs. These are seen as dirty, old fashioned, industries that are just chugging along. While the rate of growth may be higher in

the new economy, the so-called old economy contains the things people *really* need. There are no pipelines without a supply of oil and gas. There are no electronic communications without the materials to build the latest communications devices. And all of the materials required come from the Earth.

These economists see computers as a kind of abstract clean tool of the future, not realizing that the plastic box, the circuitry and the chips are made of resources that come from the Earth. Worse yet, they seem to miss the connection between Earth resources and the provision of the electrical power necessary for these devices. Coal, oil and gas provide most of our electricity and the copper wires along which it is conducted come from copper mines.

It doesn’t help that earth scientists have been so good at finding those resources that presently they are ridiculously cheap. Naturally, if people had to pay more for the resources they use, they would value them more highly. Listen to the squeals of horror as the prices of oil and gas rise, but really we should get used to it. It would be better for the future of the Earth if we slowed and reduced our

consumption of these finite resources. We don’t need to drive the enormous, energy consuming monsters that we see more and more commonly on our roads.

The contribution of Earth resources to Canada’s well being over the years has been enormous. There is a continuing, indeed expanding, demand for supply of natural resources. Therefore there are many opportunities for work in the industries that produce them.

The Mineral Industry

A review of the prices of metals over the past decade reveals that the values of precious metals like gold and platinum have fallen considerably. Other metals such as nickel and tin have fared little better. The lowering of value of the end product has caused some difficulties for the Canadian mining industry. A second and formidable challenge is presented by native land claims that cast doubt on areas available for exploration. In addition in some jurisdictions there are increasingly stringent (and eminently justifiable) environmental regulations that can increase the cost of exploration and exploitation. One result is that the Canadian mining industry has begun to look outside Canada for future prospects, but the



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large size of new discoveries in Canada like the Voisey's Bay nickel deposit in Labrador suggest that settling land claims and dealing responsibly with the environment is in the best interests of everyone involved.

Not surprisingly, trends in the pattern of employment in the mineral industry over the past decade show a steady decline such that the total number of jobs has been eroded by more than 20%. However, only a part of this decline is attributable to a downturn in mineral prices, the remainder is due to the fact that technological advances have reduced the number of people required to extract mineral resources. In any event, there are still a considerable number of jobs available. On the bright side, Canada is the principal country in the world as a source of equity financing for global mineral exploration and development. Since Canada is the leading country in the world for expertise in mineral exploration, it is the main centre for raising funds globally. This is an impressive 60% in 1998 and 55% in 1999. So, when you hear about the Prospectors and Developers Association meeting in Toronto each March you can think of the enormous amount of business being done in the corridors of the Royal York Hotel and such places. Thus, opportunities abound in Canada for those interested in mineral exploration and development worldwide.

The Energy Industry

Prices of oil and gas over the last decade have fluctuated with regular cyclicality. The price of a barrel of West Texas Intermediate Crude, that universal indicator of the health of the oil industry, has fluctuated over the last decade and is currently at a very high level. This has meant a significant upswing in the Canadian energy sector and much talk of new pipelines to take gas from the Arctic coast to market, mainly in the United States. Exploration permits for the so-called Mackenzie corridor are hot commodities at the moment. The native people in Yukon and Northwest Territories have a new interest in developing these reserves that have been known about 30 years.

Overall employment in the energy industries fluctuates with time. It is currently on the rise and will continue to rise with the price of oil and natural gas. The energy sector is the principal part of the natural resource sector's contribution to Canada's gross domestic product (GDP). Historically, from 1982 - 1998, the natural resource sectors have supplied Oil, natural gas and coal provide more than 75% of Canada's demand for energy. The contribution of hydroelectricity and nuclear plants is relatively small. This may seem odd in a country in which people in many regions refer to electricity as "hydro". The share of oil in the production of energy has fallen from 47% to 28% over the last two decades and is projected to remain at about this level over the next two decades. Conversely, natural gas has risen from 23% to 34% over the same period. Despite considerable efforts to bring alternative sources, such as wind and solar energy, to market, it is predicted that they will only supply about 7% of our total energy demand by 2020.

The large requirement for fossil fuels means that we are not meeting our commitments to the Kyoto Accord to reduce emissions of greenhouse gases. This underscores the need for energy conservation as the main means of reducing emissions.

Demand for oil products is mainly in the area of transportation and, as noted above, there has been a reduction in the amount used for residential purposes as many of us have switched to other products, mostly natural gas.

Demand for natural gas in the residential area has grown, as it has for industrial applications. In the future, it is expected that natural gas will be used to drive electricity generation. This makes the northern pipeline, a relatively urgent development.

From a job-seekers point of view, the energy industry is healthy and provides lots of opportunities for employment in all areas: exploration, exploitation and environment. As further proof that this sector of the economy is healthy, a list of the 50 fastest growing companies by revenue in the last five years includes 12 energy companies and 19 mineral companies, or 60% of the total list.

Canada is a resource rich country. It's a big country with a lot of geography and geology. It has derived enormous wealth from the Earth and yet its people don't appreciate that fact. So, I hope that if you do decide to pursue the earth sciences with a view to entering one of the resources industries, you will tell your friends, neighbours, schoolteachers and politicians about this relationship.

The bottom line is that we must get people to relate to the fact that we have exploited resources for our civilization from ancient times in tepees to modern cities and from ancient hunting methods to modern communications.

While we dig in the Earth to take advantages of its resources, we get our hands good and dirty, and we extract wealth like diamonds and oil. At the same time we have created some environmental messes, sometimes through ignorance and sometimes through neglect. It is this balance that we need to stress: if we want civilization, we have to dig some holes in the ground and if we are not careful we may make a mess.

It is worth pointing out that many people who become earth scientists have a strong bond to the environment because they were attracted to the science by the life style that many of the jobs offer: working outdoors, trying to understand complex natural systems.

The Environmental Industry

Many earth scientists work in the environment industry: one of the fastest growing and least understood industries in Canada.

Clear statistics are not available for employment in the Environment Industry but attempts are now being made by The Canadian Council for Human Resources in the Environment Industry (CCHREI) which has conducted studies on employment in the industry. According to their research, 12% of environmental practitioners are earth scientists. They conducted a survey of 1000 environmental practitioners including people from environmental and engineering consulting firms, various companies that hire environmental specialists (like natural resource companies) and government agencies. Their studies, and those conducted by Statistics Canada, allow for a conservative estimate of about 100,000 people employed in the environment industry today. Therefore we can conclude that as many as 12,000 earth scientists currently do environmental work in Canada.

Another of the ongoing CCHREI studies extracts details from all jobs advertised in the environment industry: they analysed 1400 advertisements between 1995 and 1997 of which 5% are earth science-specific and a further 25% are not specific as to the background required for the job. Clearly there are opportunities for earth scientists in the environmental field. Certainly many hydrogeologists and soil scientists can be counted among the work force.

OPPORTUNITIES IN STUDYING EARTH PROCESSES

Of course not all earth scientists work in the resource and environment industries. Although earth science programs traditionally turn out people to work in these areas, university earth science departments are increasingly taking a broader view and offering a broader education. There is emphasis on the interconnectedness of the lithosphere, hydrosphere and atmosphere.



*"There is but one ocean though
its coves have many names..."*

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This development is called Earth System Science and it provides a broader and more systematic view of earth processes and how they are interconnected.

Many earth scientists study earth processes with immediate impact on human populations. Ironically, many of us have a poor understanding of the Earth and its processes. We may experience a natural catastrophe and have no idea of the cause or the risk. We may build houses in inappropriate places and then expect the government to bail us out when our home is damaged. We behave as though human memory was wiped clean every thirty years or so.

The first thing that crosses the mind of a motorist delayed by a rock slide in the mountains is why the government allows this kind of thing to happen and why it didn't put up barriers to prevent this inconvenience. Similarly, we may fail to understand natural processes that affect our own property. Why do we continue to build on flood plains, on rapidly eroding cliffs, or on unstable rocks or soils? We seem surprised when our property slips down slope or becomes flooded and we expect society to do something about it. As a result our rates for insurance rise.

In certain areas of the Earth, we may experience earthquakes and discover we have built inappropriate structures with a resulting high level of damage and loss of life that was eminently avoidable, if we had built buildings up to better code standards.

We may experience volcanic eruptions and the hazards that go with them. We should be encouraged to learn from them and try to understand their effects. When Mount St. Helen's erupted in the western United States in 1980, the people who were killed were some of those who were studying the mountain and those who refused to move despite warnings of being in the path of destruction.

If we want to have fresh, potable water resources, we should pay attention to how we deal with that resource; the people of Walkerton, Ontario understand this now, but only under tragic circumstances. Other towns have also suffered disruptions in water supply due to poor water management practices. It is interesting to note that resistance is growing to large feedlots for cattle in Alberta, because of the threat they present to water pollution. Drought has been a reality for many Canadians in the last few years, making water a precious natural resource. Similarly, those who over-exploit water for irrigation may live to regret their choices.

Earth scientists work in all these areas: flooding, rock and landslides, earthquake prediction, interpreting satellite imagery and water resources. All these areas have direct impact on humans. Insurance companies, not to mention victims, have a strong interest in all of these natural hazards.

GEOLOGICAL SURVEYS

Other opportunities exist for earth scientists in the public service of Canada, both federal and provincial. Although funding for government science has declined considerably in the last few years, there are still vigorous geological surveys in most of Canada's provinces and of course the Geological Survey of Canada (GSC), for whom I work. You may have become aware of it a while back because of the fuss over the possible renaming of Mount Logan after the late former Prime Minister Trudeau. Sir William Logan was our first director, hired in 1842, before Canada was a country to assess Upper and Lower Canada for natural resources. Sir William Logan was declared Canada's top scientist of the millennium by Maclean's Magazine. The GSC has been around ever since and still provides earth science information for the people of Canada. Governments in Canada historically have provided fundamental earth science information in the form of maps and surveys. Government science is regarded as the objective foundation upon which other commercial or practical earth science is carried out. The knowledge base produced by government earth scientists is used not only by the mineral and energy industries as a basis for exploration but also for land-use planning, health and safety issues, hazard prediction and environmental issues. In order to be useful it must be continually upgraded.

ACADEME

If you want to be an academic and do research the time couldn't be better. Academe is the area responsible for the training of new earth scientists and for the conduct of much of the fundamental research in earth science.

As background facts: research expenditures per capita in Canada are half those of Switzerland, about three quarters those of the United States and about the same as comparable countries like Australia and France. We have about four and half research scientists and engineers per thousand of our population. This figure is much lower than that for Japan and the United States, about the same as the UK and higher than Italy. Canada is a medium level country in the practice of science and, although it is a pity that science is not a higher priority, there are plenty of opportunities here.

An examination of the number of university science degrees granted in Canada reveals that very high numbers of biologists and engineers are produced annually, followed by psychology and computer science at about half the rate. Relatively fewer bachelors degrees are granted in physics, chemistry and earth science. Similarly with doctoral degrees the numbers are high for engineering and biology, followed by chemistry at about half the level. Fewer doctorates are awarded in physics, psychology, earth science and computer science. However, there has been a steady increase in doctoral degrees in all the sciences over the last decade. So we are training more highly qualified personnel but we are probably only keeping up with the growth in population and we are certainly not taking account of the graying population.

An optimistic note for those planning post-graduate work is that the demand for science faculty in universities is high in Canada. Earth scientists will be in demand over the next five to ten years for faculty positions. This is not because the earth science department faculty are fossils, but many of them will be soon!

Whether you work in a geological survey or in academic research, there are all sorts of opportunities. You might get to travel to exotic places and spend time outdoors doing fieldwork. Maybe you could run a geophysical survey on land or on the sea in order to find out more about what lies hidden beneath the Earth's surface. Or perhaps drill out an ice core to study past climate changes; or prepare a geological map in a high-tech digital format. Maybe you want to find out more about the history of life on Earth through the study of fossils like dinosaurs or trilobites. You could always study minerals and expand the search for diamonds that are fast becoming an important part of the Canadian economy. You might also want to study the ocean from satellites and try to understand the effects of El Niño on our climate. Or perhaps you have always wondered how mountains form and how plate tectonics affects the distribution of earthquakes and volcanoes on Earth.

Whatever you may decide to do, let me emphasize that now is a good time. Resource industries are in good health: there are jobs in searching for resources; there are innumerable opportunities in dealing with environmental questions; there are opportunities in many science organizations because of the graying of the scientist population. Universities need professors now and will need many more in the years to come.

The important thing these days is to be as broadly qualified as possible. Keep a foot in at least two areas of science. Earth Science is great because it involves physics, chemistry and biology. There are geophysicists, geochemists and geobiologists (paleontologists).

In Canada we do earth science as well or better than anyone in the world. From a global point of view, earth scientists are at the centre of knowledge that is required to make life on this planet sustainable. There is a bright future. There are plenty of chances to get plugged in to this broad and exciting area.

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FURTHER READINGS ON THE WEB

Canadian Council for Human Resources in the Environment Industry
<http://www.cchrei.ca/welcome.html>

Canadian Geophysical Union (geophysics - hydrology in universities)
<http://www.cgu?ugc.ca/>

Canadian Geoscience Council (national issues in earth sciences)
<http://www.geoscience.ca/>

Canadian Quaternary Association
<http://www.mun.ca/canqua/>

Canadian Society of Exploration Geophysicists (geophysics in the resource industries)
<http://www.cseg.org/>

Canadian Society of Petroleum Geologists (for those interested in Petroleum Geology)
<http://www.cspg.org/>

Careers in Geoscience (specifically dedicated to career choices)
<http://www.science.uwaterloo.ca/earth/geoscience/careers.html>

Deep River Science Academy (real science experience for high school students)
<http://www.drsa.ca/>

EarthNet (A virtual resource centre for Earth Science educators)
<http://earthnet.bio.ns.ca/>

EdGEO National Workshop Program (earth science workshops for teachers)
<http://www.edgeo.org>

Geological Association of Canada (an excellent link to Canadian university departments of earth sciences, Canadian geological surveys and a host of other useful links)
<http://www.gac.ca/>

EarthSciences Sector of NRCAN
<http://www.nrcan.gc.ca/ess/>

Mineralogical Association of Canada (for those interested in minerals)
<http://www.mineralogicalassociation.ca/>

Mining Matters (education resource on mining)
<http://www.pdac.ca/miningmatters/index.html>

Prospectors and Developers Association of Canada (for those interested in mining)
<http://www.pdac.ca/>

Sir William Logan (after whom Mount Logan is named)
http://www.nrcan.gc.ca/gsc/logan/index_e.html

NOTES:



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