

Department of Earth Sciences Strategic Plan

Summary

The Department of Earth Sciences aims to

- develop and maintain excellence in teaching and research
- become the best Earth Sciences department in Canada
- become a leading centre internationally.

The department has existing strengths in:

- Petrology - geochemistry - economic geology
- Sedimentary basins and petroleum geoscience
- Geophysics
- Environmental geoscience.

Our areas of strength and focus align with the strategic plans of Memorial University and Faculty of Science, and coincide with the engines of our provincial and national economies. We recognize the links between environmental stewardship and resource exploitation. We foster pure research as the backbone of any science and source of seeds for applied research.

Our undergraduate and graduate programs are designed to produce first-rate scientists possessing the skills to succeed in the industrial, government and academic sectors and the knowledge required to meet provincial and national professional registration standards. In order to maintain and improve our programs we will continue to seek and adapt to new opportunities in our diverse science.

In order to achieve our goals we need replacement of retiring and resigning faculty, growth through opportunity hires and filling of positions that have previously not been replaced.

Recent retirements are listed in Table 1. A list spanning the past 6 years can be found in [Appendix A](#).

Name	Area	Specialization	Year
Quinlan, G.	Geophysics	Tectonics/Modeling	12/2010
Bentley, S.	Marine Geology	CRC Seafloor Mapping	01/2011
Wilson, M.	Geochemistry	Economic Geology	09/2011

Retirements and resignations, 2010 to date.

In the next five years at least two faculty members will retire. These losses, together with those in Table 1, will impact teaching (graduate, undergraduate) and research capabilities. Critically, our ability to provide a program that meets the requirements of professional registration (P.Ge.) will be threatened without careful management.

Recent appointments are listed below. A list spanning the past 6 years can be found in [Appendix](#)

A.

Name	Area	Specialization	Nature	Year
Cheng, T.	Hydrogeology	Contaminant and geochemical hydrology	Regular	7/2010

Recent appointments.

In the short term (2 years) replacement positions are required to maintain our research and teaching strengths, and to maintain professional registration requirements, including the following positions (listed alphabetically): applied seismology; structural geology of sedimentary basins; geomicrobiology; and tectonics and the evolution of orogenic belts.

The department is currently (February 2012) pursuing two potential opportunity hires: 1) the NSERC-Chevron Industrial Research Chair in Reservoir Characterization; and 2) the NSERC-Hibernia (Exxon-Mobil) Industrial Research Chair in Basins Analysis.

Plans for future hires in the longer term (>2 years) are also provided herein.

Appendices [A](#), [B](#), [C](#) and [D](#) contain detailed information supplementing that in the main document.

Setting the Stage: University and Faculty of Science Strategic Plans.

The draft [Strategic Plan of Memorial University](#) (link will be updated when it is officially posted on the university website) has four main goals:

- 1) attract, retain, support and celebrate faculty, staff and students engaged in research;
- 2) provide supports for an environment of research excellence;
- 3) support fundamental and applied research in Strategic Research Themes;
- 4) engage with communities and partners locally, nationally, and internationally to create, share, and apply research.

Our historic, existing and planned research strengths align well with the University's Strategic Research Themes, including:

- Arctic and Northern Regions
- Community, Regional, and Enterprise Development
- Environment, Energy, and Natural Resources.

The Faculty of Science [strategic plan](#) has a vision to create "a research-intensive Faculty that is renowned both for the caliber of our research and the quality of our graduates" and is "dedicated to international excellence in research and teaching to the benefit of people locally, nationally, and internationally". Research should "advance knowledge and produce high caliber graduates with the expertise to play a vital role in the socio-economic and industrial development of the Province of Newfoundland and Labrador." Memorial's location is a major strategic asset for research and provides it with a unique "opportunity for growth" in two main strategic areas:

- Marine Sciences
- Natural Resources and Energy

Consultative Process

A Strategic Planning Committee ([Appendix B](#)) was set up in November 2010 with a mandate from Faculty in the Department of Earth Sciences.

- December 2010 – January 2011 – consultation within the Department.
- April 2011 – draft document completed and circulated to faculty.
- May 2011 – initial draft discussed at a faculty meeting.
- May-September 2011 – further faculty input.
- October-December 2011 – revision of the document.
- December 2011 – circulation to faculty and discussion at faculty meeting and final approval.
- February 2012 - minor editing.

Goals and Areas of Research and Teaching Strength

The Department of Earth Sciences is uniquely positioned to contribute to the University and Faculty of Science strategic plans. The Department has existing and historic research and teaching strengths that are recognized worldwide. Petroleum and mineral resources are critical to the provincial economy and the Department will play a crucial role in the continued development of the natural resources industries in the province.

The goals of the Department of Earth Sciences are:

- 1) To become the premier department for research and teaching in Earth Sciences in Canada, and a leading institution globally.
- 2) To capitalize on faculty expertise by offering courses that provide both depth and breadth of comprehension.
- 3) To integrate the diverse sub-disciplines of Earth Sciences in order to facilitate understanding of the solid Earth, hydrosphere, atmosphere, and biosphere, their interactions and inter-relationships and comparisons to other planets;
- 4) To provide an undergraduate program, with a significant field and laboratory training, that provides students with:
 - i. the ability to think critically and express themselves logically and clearly in both written and oral forms;
 - ii. the academic requirements for professional registration with the Professional Engineers and Geoscientists of Newfoundland and Labrador (PEGNL) and other Canadian and international regulatory bodies; and
 - iii. a knowledge of the Earth Sciences from which they can continue their education at

the M.Sc. or Ph.D. levels or obtain employment in the public, private, or non-profit sectors of Earth Science or a related field. We wish to produce outstanding scientists who can apply their knowledge and intelligence to pure and applied research endeavours;

- 5) To provide an integrated field- and laboratory-based training of graduate students such as to create cutting edge scientists with a solid knowledge of the Earth Sciences and the ability to think critically and produce creative, internationally competitive research;
- 6) To capitalize on our strategic location in a province with geology ranging from the most ancient to recent rocks, and associated natural resources, and use this natural laboratory for research and training in the Earth Sciences;
- 7) To support and develop interdisciplinary research and teaching with other academic units at the university with parallel and complementary interests;

The specific areas of research and teaching strengths in the Department of Earth Sciences are listed below (see also [Appendix C](#)). The Department wishes to maintain and develop these areas.

- Petrology, Geochemistry and Economic Geology
- Sedimentary Basins and Petroleum Geology
- Geophysics
- Environmental Geoscience

Proposed Faculty Appointments

Descriptions of the potential faculty appointments in the immediate and longer term are provided below in alphabetical order. A brief rationale is provided for the Opportunity and Immediate hires. The detailed descriptions and rationale for the immediate hires and longer-term positions is outlined in [Appendix D](#).

- 1) Immediate Term (<2 years)
 - i. Applied Seismology (Geophysics)
 - ii. Geomicrobiology
 - iii. Structural Geology of Sedimentary Basins
 - iv. Tectonics and Evolution of Orogenic Belts
- 2) Medium Term (3-4 years, order to be decided in future consultations)
 - i. Computational Geophysics
 - ii. Earth Systems Biogeochemist
 - iii. Geodynamics
 - iv. Petroleum Geophysics
 - v. Volcanology and Volcanic Stratigraphy

- 3) Long Term (>4 years, order to be decided in future consultations)
 - i. Astrobiology
 - ii. Isotope Geochemistry
 - iii. Paleobiology and Paleoenvironments of Early Ecosystems
 - iv. Whole Earth/Planetary Geophysics
- 4) Opportunity Hires
 - i. NSERC-Chevron Industrial Research Chair in Reservoir Characterization
 - ii. NSERC-Hibernia Mobil Industrial Research Chair in Basins Analysis

A Working Document

This document is considered a working document that is fluid and subject to change with departmental approval. It provides a general framework for the future of the department. The department will review this document in the context of opportunities and programmatic requirements that may affect our ability to offer our undergraduate and graduate programs.

December 2011 (with minor edits, February 2012).

Appendix A

Faculty Changes 2002-2012

Retirements & Resignations

Name	Area	Specialization	Year
Myers, J.	Structure	Tectonics/Mapping	12/2006
Meyer, R.	Petroleum Geology	Petroleum Geology	05/2007
Miller, H.	Geophysics	Potential Fields (PF)	08/2007
Hiscott, R.	Sedimentology	Clastic Sedimentology	08/2007
Gale, J.	Eng./Hydrogeology	Hydrogeology	12/2007
Wright, J.	Geophysics	Heat flow	12/2007
Enachescu, M.	Geophysics	Petroleum	12/2007
Quinlan, G.	Geophysics	Tectonics/Modeling	12/2010
Bentley, S.	Marine Geology	Seafloor Mapping	01/2011
Wilson, M.	Geochemistry	Economic Geology	09/2011

Appointments

Name	Area	Specialization	Nature	Year
Layne, G.	Geochemistry	Analytical, SIMS	Inco-Chair	May-06
Bentley, S.	Marine Geology	Seafloor Mapping	CRC-II	Jul-06
Ziegler, S.	Biochemistry	Aquatic Chemistry	CRC-II	Aug-06
Farquharson, C.	Applied Geophys	EM-Potential Fields	Regular	Jul-08
MacQuaker, J.	Petroleum Geol.	Reservoir	Regular	Sep-08
Morrill, P.	Environmental	Geochemistry	Regular	Sep-08
Piercey, S.	Economic Geology	NSERC IRC - Mineral Deposit	NSERC IRC	Dec-09
Cheng, T.	Hydrogeology	Fluid Flow	Regular	Jul-10

Appendix B

Strategic Planning Committee

The Strategic Planning Committee was established in 2010. The current members of this committee are: Steve Piercey (Chair), Ali Aksu, Colin Farquharson, Chuck Hurich, Duncan McIlroy, Penny Morrill, Paul Sylvester, and Sue Ziegler. Sue Ziegler was on sabbatical in 2010-2011 and was replaced by Tao Cheng for 2011-2012.

Appendix C

Areas of Research Strength

Petrology, Geochemistry and Economic Geology

Since the 1970s, the Department has maintained internationally-recognized strengths in field- and laboratory-based research in petrology, structural geology, tectonics, Appalachian and Canadian Shield geology, mineral deposits, analytical geochemistry, trace element and radiogenic isotope geochemistry, and geochronology. The Department aims to continue to be an international hub for research and teaching in these fields. The strategic advantages of developing this research and teaching area are:

1. The first-class natural geological laboratory of the province including its associated mineral deposits;
2. The outstanding analytical infrastructure that has been developed at the university by members of the group over the past 20 years;
3. The opportunity for collaboration between Memorial, the Geological Survey of Newfoundland and Labrador, and with local mining and mineral exploration industries;
4. The importance of mineral resources to the provincial economy and of our training of students to work in this sector.

The Petrology, Geochemistry and Economic Geology group requires faculty members who have expertise in the nature and origin of the basement rocks and mineral deposits of the province and the ability to develop innovative methods for studying these rocks both in the field and in the laboratory. Understanding basement rocks is a fundamental part of understanding the evolution of the planet and provides the context in which mineral deposit genesis is understood and in which exploration is carried out. It will become increasingly important to hire faculty members in this group that wish to collaborate across discipline boundaries and understand the planetary scale context of their work.

Sedimentary Basins and Petroleum Geology

The Department of Earth Sciences has a strong history of research related to understanding the processes that underpin the evolution and fill of sedimentary basins and their associated petroleum resources. Our faculty are internationally recognized with strengths in:

1. Siliciclastic sedimentology, sediment transport, and marine sedimentology;
2. Ichnology;
3. Palynology;
4. Sedimentary geochemistry (provenance analyses, fluid rock interactions during burial and diagenesis, role of microbial processes in organic-rich sediments);
5. Primary productivity on continental shelves and its bearing on source rock and shale-gas reservoirs; and

6. Carbonate diagenesis and reservoir quality.

Faculty are working to develop the fundamental precepts necessary to enhance our understanding of the sediment fill and stratigraphic geometries present in ancient basins developed both in passive margins and thrust belts. This research has direct application to the oil industry both locally in Atlantic Canada and internationally. The work provides the bases on which potential source rocks are identified, the most prospective oil reservoirs are located, the impact of diagenetic processes on reservoir quality is understood and unconventional oil and gas resources are discovered. The sedimentary basins and petroleum geology group sees opportunities in:

0. Structural geology of sedimentary basins.
1. Facies analyses and process investigations of sediment transport mechanisms in either marginal marine (deltaic / estuarine) systems or deep basinal dispersive systems;
2. Shelf margin sedimentary processes;
3. Diagenesis of unstable siliclastic detritus and coarse grained siliciclastic sedimentary rocks and its impact on sandstone petroleum reservoir facies;

Linking these research foci with reservoir characterization and with understanding sedimentary basin evolution on a large scale would complement and enhance ongoing strengths and allow us to capitalize upon ongoing opportunities within the oil and gas sector in Newfoundland and Labrador and globally.

Maintaining our strengths in sedimentary geology and increasing our presence in sedimentary basin studies and petroleum geology is critical for our undergraduate and graduate programs. Our location provides a unique natural laboratory that can be used to study the origin and evolution of sedimentary basins and their resources.

We have current opportunities, courtesy of Chevron and Hibernia (Exxon-Mobil), to build a critical mass of expertise linked to petroleum geology. The proposed NSERC-Chevron Industrial Research Chair, with its focus on reservoir characterization, and the proposed NSERC Hibernia (Exxon-Mobil) Industrial Research Chair, with its focus on large scale basin processes, will provide the springboard to tie together “blue sky” and applied research and make the sedimentology- petroleum geology group world leaders in the field.

Geophysics

The Department has an excellent reputation with both the oil & gas exploration industry and the mineral exploration industry for producing geophysics graduates (both BSc and MSc) with broad, applied knowledge that makes them valued employees. The Department is recognized for outstanding research in exploration geophysics, both hydrocarbon exploration and mineral exploration, and in crustal geophysics. Research for exploration includes methodological development, computational techniques, and theory, and in the fluid dynamics of deposit formation. The Department has a history of geophysical investigations of the crust and upper mantle. Because of the importance of resource exploitation to the economy of Newfoundland and Labrador, it is both natural and strategic that the Department maintains its research strengths in Applied Geophysics, an area of study that is aligned with the natural resource theme of

Memorial's strategic plan. In addition, Applied Geophysics meshes very well with the applied research goals of federal and provincial funding agencies; every effort should be made to take advantage of these facts. We expect a retirement in the field of Applied Geophysics within the next two years. This will impact our ability to maintain the Geophysics program. In order for the Department to be able to produce quality geophysics graduates in the future, and thus maintain our reputation and career opportunities for our graduates, the number of geophysics faculty must be maintained or increased and we will seek a replacement when this retirement occurs.

Environmental Geoscience

The environmental geoscience group in the Department of Earth Sciences has traditionally been strong in the fields of hydrogeology, geochemistry, and stable isotope chemistry. Within the past 6 years the environmental geosciences group has been rejuvenated with the addition of 3 new faculty members (replacing Drs. Wadleigh, Gale, and Abrajano) including a CRC Chair in Environmental Sciences. The Environmental Geoscience group is strong in laboratory and field research at both the undergraduate and graduate levels, with specialties in biogeochemistry, isotope geochemistry, planetary processes, environmental geochemistry, contaminant hydrogeology and environmental and climate change. These areas of strength are required to develop strategies for sustainable use of resources and adaptation to global change. The Environmental Geoscience Group aims to continue to grow in the above fields and, in conjunction with the CREAT Network, is developing state-of-the-art laboratories for stable isotope measurements, environmental geochemistry, and groundwater modeling.

The emerging field of Geomicrobiology links geology, geochemistry and atmospheric science and has the potential to be of importance in the applied fields of contaminant hydrogeology, mine waste remediation and climate change. Existing Faculty expertise and laboratory facilities in Environmental Geosciences provide an excellent opportunity to expand the Undergraduate and Graduate curricula in this field with the addition of a microbiologist. Such an appointee would naturally work across disciplines and a cross-appointment with Biology and/or Biochemistry may be possible.

Appendix D

Proposed Faculty Appointments -- Detailed Descriptions and Rationales

Identified (immediate to short-term < 2 years)

1. Applied Seismology (Geophysics)

The Applied Seismology group presently has expertise in theoretical and computational seismology as well as in acquisition, processing and interpretation of seismic data. The department wishes to maintain teaching and research strength in Applied Seismology consistent with the needs of the undergraduate and graduate programs and the strong connection between seismology and departmental strengths in oil and gas and mineral exploration. The Earth Sciences department has provided a large number of Geophysics students to the O&G and mining communities many of which have returned to Newfoundland as senior Geoscientists. It is in the best interests of the Department, Memorial and the students that we continue to provide a strong applied geophysics program that provides outstanding geophysicists for the job market.

To maintain a balance of expertise in the Applied Seismology group, we anticipate that this position will be filled by a candidate with interests in the collection, processing and interpretation of seismic data and the application of seismology to the solution of geologic problems at a range of Earth scales. This person might have specific interests in the areas of basin analysis, reservoir characterization, seismic inversion or seismic imaging.

Need:

- The Geophysics group has lost 4 faculty members in the last 3 years - only one of those positions have been replaced.
- The ES department offers 7 courses that are core to the undergraduate Geophysics stream. A Geophysics faculty member has traditionally taught the Global Tectonics course as well. In addition a significant number of students in other Earth Sciences streams and the Environmental Physics program participate in the Geophysics course offerings.
- We presently have 4.5 teaching faculty.
- Annually there are approx. 20 students in the 3rd and 4th year of the Geophysics stream (20% of the Earth Sciences undergraduate cadre).

In addition, this position would build on the developing program in Computational Geophysics that is a collaboration between members of the Earth Sciences, Physics and Physical Oceanography and Mathematics Departments focused on applying High Performance Computing to a broad range of geophysical applications many of which are directly connected to the Natural Resources sector.

2. Geomicrobiologist

A geomicrobiologist would fill a gap in our Earth Science Department by fleshing out our strengths in Earth Systems Science, Planetary Sciences, Biogeochemistry, and Petroleum Geology. In particular we seek a candidate who would further contribute to a growing research/training expertise in earth system evolution, environmental change, and planetary sciences. Bacteria and Archaea occur in almost any environment where there is sufficient water for their survival, and they can have a considerable influence over the cycling of elements on Earth. The prospective geomicrobiologist would assist in building research capacity in Earth Sciences through his/her research on one or more of the following areas:

- rock-fluid-biofilm interactions;
- epilithic microbial biofilms in systems in extreme environments such as acid mine drainage, sites of serpentinization, arctic environments, and hydrothermal environments;
- impact of microbial carbonate precipitation on the weathering of ultramafic rocks;
- hydrocarbon reservoir biodegradation;
- climate change impacts on past and present microbial carbon cycling in high latitude ecosystems;
- microbial biomarkers and paleoclimate reconstruction.

Research interests of this individual may include, but are not limited to, biomineralization, origins of life, microbial metabolic controls of elemental cycles, bioremediation, extremeophiles including cryogenic life, microbial biomarkers and past climate, and mineral-microbe interactions. This is an exciting and growing field of research with potential candidates spanning a range of applied and theoretical studies; addressing the extreme limits for the distribution of life on this planet, theorizing and exploring the question of life on other planets, and examining applications of biology to mine tailings, oil spills, and the role of biology and biochemistry in the creation of mineral and petroleum deposits.

Need:

There is a need for this expertise to bridge gaps in our departmental strengths growing in the area of earth system science and biogeochemistry. These types of research programs are currently funded through agencies including the Canadian Space Agency and NSERC Strategic Grants Program in addition to Discovery Grants held by individuals in our department. Immediate need for this position is due to the lack of true microbial ecologists with interests in earth system processes and linkages with geochemical transformation here at MUN. Furthermore, this position provides a potential linkage with other departments in the Faculty of Science (e.g., Biochemistry, Biology, Geography) and could potentially be jointly appointed between two departments (e.g., as is currently being planned at the University of Alberta).

3. Structural Geology of Sedimentary Basins

A tenure-track, Assistant Professor candidate is sought who employs modern techniques of structural analysis in deformed soft-rock terranes. Emphasis is on analysis of basin-forming structural associations, including one or more of extensional, strike slip and salt/mud diapiric systems. The candidate must have experience working with both shallow-crustal seismic

reflection data sets and on-land exposed examples of these associations. The candidate must have expertise in quantitative analysis including construction, interpretation and restoration of balanced cross-sections, and must have an interest in forward modeling of structures on appropriate scales. The candidate must have a track record in the application of modern software appropriate to this field of analysis. The candidate must be able to collaborate with specialists in other sub-disciplines represented in the department, including workers in shallow-crustal geophysics, basin-scale geodynamics, and stratigraphic-sedimentological basin analysis. A strong record of research publication and collaboration is essential. The faculty member must be qualified to teach courses in structural geology at introductory to senior undergraduate levels, as well as modern methods of geological mapping techniques (including field schools). The candidate must be prepared to develop graduate level courses in advanced analysis of soft-rock structural associations related to basin formation, and basin-forming tectonic processes. This position would provide the potential to build on existing expertise in the department and would help interface with existing strengths in soft-rock structural geology, stratigraphy sedimentary facies analysis, petroleum geology, and the burgeoning basin analysis group at Memorial. Furthermore, the position could take advantage of the timely opportunity to carry out fundamental research directly related to the Newfoundland and Labrador (and global) oil and gas industry. The candidate must have the ability to carry out an externally funded research program through NSERC and should have the potential to attract industry funding.

4. Tectonics and Evolution of Orogenic Belts

The Department of Earth Sciences has had a strong tradition of research in global tectonics, the regional geology and tectonics of crystalline belts, and the evolution of orogenic belts, having made outstanding contributions to the understanding of Appalachian tectonics and crustal evolution (e.g., previous faculty – Hank Williams, Peter Cawood, Jamie Jamieson). At present, however, we have very little presence in field-based studies of the Appalachians in tectonics and orogenic belt development. Furthermore, with the increase in focus on laboratory-based science in Earth Sciences, our presence and ability to train students in field geology is less than it has been in the past, and this could be a major problem for our department with potential retirements in the next decade. This position would be at tenure-track, Assistant Professor-level candidate with an emphasis on field-based studies of orogenic belts integrating geological mapping with modern quantitative methodologies to solve regional problems in ancient and modern orogenic belts. Quantitative methods may include numerical modeling of deformational processes or thermochronology (Ar-Ar, U-Th-He, fission track dating). An individual with a previous history of research in the Appalachians, similar orogenic belts, and a desire to work in the Appalachians would be welcomed. The individual must be able to collaborate with existing expertise at Memorial, have an outstanding publication record, and the proven ability or potential to develop a solid, externally funded research program. The individual would be responsible for teaching some of the following undergraduate level, tectonics, crustal evolution, regional geological evolution of orogenic belts, and field school courses at the undergraduate level. At the graduate level the candidate would be expected to develop courses in the regional geological development of crystalline terranes and tectonic evolution of mountain belts.

Opportunity Hires (<2 years)

There are currently two opportunity hires being considered by the Department of Earth Sciences. These positions do not immediately contribute to our teaching requirements, but help us build research capacity and expertise in geophysics, sedimentary basins and petroleum geology. As they do not immediately contribute to our teaching requirements they are considered separate from the positions above.

1. NSERC Chevron Industrial Research Chair in Reservoir Characterization

This position is an opportunity hire provided by Chevron with the anticipation of matching funds from the Research and Development Corporation of Newfoundland and Labrador and the NSERC Industrial Research Chairs program. This position will focus on the determination of reservoir architecture, establishing geological flow units, constructing reservoir models and identifying petroleum reserve growth potential.

2. NSERC Hibernia Industrial Research Chair in Basins Analysis

This position is an opportunity hire provided by Exxon-Mobil with the anticipation of matching funds from the Research and Development of Corporation of Newfoundland and Labrador and the NSERC Industrial Research Chairs program. The position will be in the broad area of sedimentary basins analysis.

Identified medium-term positions (3-4 years)

The positions are not listed in order of planned hiring.

1. Computational Geophysics

Description: Development of numerical techniques and algorithms, and computer programs, for modeling physical fields and processes within the Earth, and application of these programs to the study of the Earth's interior. Examples of such research include: computing solutions to the elastic wave equation of seismic exploration methods and to Maxwell's equations for electromagnetic exploration methods in complex, anisotropic, frequency-dependent, three-dimensional Earth models; and computing solutions to the fluid dynamic and thermodynamic equations of mineral deposit formation.

A Computational Geophysics position would take advantage of the momentum being generated by the ACOA- and RDC-funded project "High Performance Computing for Geophysical Applications", an interdisciplinary project between the Departments of Earth Sciences, Physics and Physical Oceanography, and Mathematics and Statistics. Such a position would be viable because of the high-performance computing facilities available at MUN: the Computing, Simulation and Landmark Visualization Facility; the massively parallel computer being purchased by the HPCGA project; and ACEnet, the Atlantic Canada Computational Excellence Network. The research performed by the holder of this position, and the software generated, would be of relevance to other researchers within the Department and within MUN, and to the resource exploration industries.

2. Earth Systems Biogeochemist

A candidate with research focusing on interactions among atmosphere, biota, and lithosphere to include but not limited to the context of climate change, elemental cycles, and paleoclimate reconstruction. Research interests in planetary surfaces, environmental monitoring, and carbon

cycling and climate change would be an asset. For example, individuals interested in high latitude environments including soil, permafrost, and peatland systems would be well suited to this position. This candidate would be an interdisciplinary scientist who would likely have modeling experience and interests in applied remote sensing techniques, however, they may not be a specialist in either of these techniques but rather a user and therefore very capable in instructing students in these approaches. Such an individual could make use of remote sensing and computational modeling capabilities on campus but provide a stronger expertise in their use within our department. This individual could help provide some linkage between our current expertise in environment geochemistry and future development of earth or planetary process sciences.

Need:

There is a need for this expertise in systems modeling and approaches suited to the study of environmental change to bridge gaps in our departmental strengths in order to further grow in the area of earth system science and biogeochemistry. These types of research programs are currently funded through agencies including the Canadian Space Agency and NSERC Strategic Grants Program in addition to Discovery Grants held by individuals in our department. This is a burgeoning area of research driven by the need for developing strategies for sustainable use of resources and adaptation to climate change and such a position is needed to be filled in the near future to continue the new momentum in this area within our department.

3. Geodynamics

We would envisage appointment at Assistant or Associate Professor, aimed at understanding the Earth as a dynamic planet aimed at physically modeling the broad range of Earth processes, particularly the formation and deformation of sedimentary basins. A geodynamicist would contribute to basin analysis by modeling whole basin formation/deformation as well as structural/stratigraphic associations on a smaller scale within basins. The candidate should be interested in computer and/or analog modeling of sedimentary basin formation and deformation. Their research would be aimed at providing insight into the mechanical controls on the geometric and kinematic evolution of structural associations, and their variability in space and time; and their influence on the stratigraphic evolution of the architecture of basin deposits. There should be an emphasis on passive margin basins, so that lessons learned may be from North Atlantic examples or applied to them. This position would provide the potential to build on existing expertise in the department and would help interface with existing strengths in soft-rock structural geology, stratigraphy sedimentary facies analysis, petroleum geology, and the burgeoning basin analysis group at Memorial. Furthermore, the position could take advantage of the timely opportunity to carry out fundamental research on passive margins that has direct relevance to the N&L offshore oil and gas industry. The candidate must have the ability to carry out an externally funded research program through NSERC and should have the potential to industry funding and take advantage of the local oil and gas industry.

4. Petroleum Geophysics

The Petroleum Geophysics position could be focused on a broad range of research themes potentially including reservoir characterization, petrophysics, basin analysis and seismic imaging. Such a position would compliment and broaden our present strength in seismic acquisition, processing and hard rock seismology in both teaching and research by bringing state-

of-the-art oil and research to the Department of Earth Sciences.

The oil and gas industry plays a major role in the economy of Newfoundland and Labrador. A Petroleum Geophysicist would be relevant to Memorial's Strategic Plan for Research as well as bring relevant expertise to the Province and have excellent potential for collaboration with several new chairs in the Petroleum Engineering program.

5. Volcanology and Volcanic Stratigraphy

This position would be a tenure-track position at the Assistant Professor level that would undertake integrated field and laboratory research aimed at understanding physical and chemical volcanic processes. S/he could have interests in the evolution of the surface of the Earth and other planetary surfaces; the relationship of volcanism with formation and evolution of the atmosphere/ hydrosphere and climate change; and volcanic hazards. Integration with existing strengths in mineral deposits, climate change, isotope geochemistry and regional tectonics would be greatly valued. In particular, this candidate could build links with geomicrobiology, earth systems geologists/geochemists concerned with hydrosphere-biosphere-lithosphere interactions, economic geologists working in Archean through modern volcanogenic massive sulfide deposits or modern day seafloor hydrothermal systems, and petrologists and isotope geochemists studying the origin and evolution of planetary crusts. This individual would be expected to contribute to the development of new analytical infrastructure such as for electron microprobe analysis to support their research. They could also make use of existing infrastructure such as remote sensing and computational modeling capabilities, or micro-analytical/geochemical tools applied to the analysis of particulates (e.g. ash) or volcanic gases. The candidate would develop an undergraduate course in volcanology and contribute to existing courses in petrology, geochemistry and/or environmental geology, depending on their specific expertise and interests. This position is proposed in light of potential retirements in hard rock geology in the next decade.

Longer term positions (>4 years)

These are not listed in order of planned hiring.

1. Astrobiologist

Astrobiologists seek to understand the origin of the building blocks of life, how these molecules came to be and how they were organized to generate life. Further, these scientists seek to understand how life is impacted by planetary processes and how life influences planetary processes. Candidates for this position would be expected to have research expertise in areas such as:

- Pre-biotic geochemistry
- Thermodynamics, Disequilibrium and Evolution (TDE)
- Meteorites
- Impacts
- The origin(s) of life
- Habitability in extreme environments

- Icy Environments
- Geomicrobiology of extremophiles
- Microbial biomarkers

Directed at fundamental questions relevant to earth and planetary evolution, an astrobiologist would further contribute to a growing research/training expertise in earth system evolution and planetary sciences (i.e. astro- or exo-biology).

2. Isotope Geochemistry

This position would be a tenure-track position at the Assistant Professor level that would be a candidate who utilizes isotopic methods to understand the evolution of Earth and other planetary systems, and integrates their expertise with other researchers in the Department of Earth Sciences (e.g., economic geology, petrology, environmental geology) and other disciplines at Memorial University (Geography, Biology, Ocean sciences) and participate in the interdisciplinary Environmental science program. This person could be a tracer isotope specialist (Rb-Sr, Sm-Nd, Pb-Pb, Lu-Hf, Re-Os), a “nontraditional” stable metal (Li, Mg, Ca, Cr, Mo, Fe, Cu, Zn) isotope geochemist or a U-Pb geochronologist, or have expertise in one or more of these components of isotope geochemistry. Ideally the selected candidate would help rebuild the analytical facilities for isotope geochemistry in the Department of Earth Sciences and especially assist with the acquisition of a new thermal ionization mass spectrometer (TIMS) and/or multi-collector magnetic sector ICPMS, at the end of their lifetimes. This position is proposed in anticipation of potential retirements within the next decade in the hard rock and economic geology area of the department.

3. Paleobiology and Paleoenvironments of Early Ecosystems

This position is at the Assistant Professor level and will be focused on understanding the: 1) the evolution of macroscopic organisms; 2) the evolution of the metazoan; and 3) global ecological changes associated with the evolution and diversification of macro-organisms. The research would take advantage of the opportunity to study world-class locations including, but not limited to: the Mistaken Point Biota near Portugal Cove South (with subsequent discoveries elsewhere on the Avalon and Bonavista Peninsulas), and the establishment of the global stratotype sections for both the Precambrian-Cambrian boundary and the Cambro-Ordovician boundary in Newfoundland there has been significant focus on the palaeontology of Newfoundland. This position would be aimed at understanding global issues in paleobiology and paleoenvironments and would complement the growing industry profile in the department and would complement a core of excellence in several disciplines complimentary to study of early ecosystem biogeochemistry (Morrill), stable carbon isotopes (Azmy, Ziegler); sedimentology (Hiscott, Macquaker, McIlroy); palaeontology (Burden; McIlroy); volcanoclastic sedimentology/chronostratigraphy (Dunning; Hanchar, Wilton), and ongoing research by other groups at Oxford University and the Geological Survey of Newfoundland and Labrador. The candidate would be expected to teach undergraduate and graduate courses in paleontology, stratigraphy, and sedimentology and would be expected to carry out an externally funded research program.

4. Whole Earth / Planetary Geophysics

Our view of this is a bit sketchy at present but the main idea is the Geophysics curriculum and research portfolio is focused on ‘Exploration Geophysics’ because that is the predominant

interest of our undergraduate student body. Growth into Planetary Physics would broaden both the teaching and research base of the department in an area that is not well covered at MUN and has growing interest from students.

Demonstrated Need

Given the demographics of the Department of Earth Sciences, there exists the potential for rapid change in the make up of the faculty over relatively short periods of time. This could significantly impact our abilities to deliver our undergraduate and graduate teaching and research programs. In light of this, the Department reserves the right to re-evaluate this document and order of hiring in light of demonstrated teaching needs and the ability to provide undergraduate programs that meet the requirements of Professional Registration.

Opportunistic Hiring

It is recognized that opportunities may arise to fill positions in fields consistent with this Strategic Plan using external funding sources (e.g., NSERC or RDC Industrial Chairs). Current examples include the Chevron and (possible) Hibernia Chairs. These opportunities will be considered sympathetically by the Department. Opportunities that lie outside the Strategic Plan will be considered by the department on a case-by-case basis, and, where possible, negotiations will be conducted with potential donors in order to maximize the benefit to the Department's aims. All opportunities will be subject to open and informed discussions. Opportunity hires are not considered replacement positions for regular faculty, although they may complement strengths in the department, but they are considered capacity building and growth positions.

Championing of Positions

The positions outlined above represent a broader departmental plan of which most should be replaced to ensure both academic and research programmatic maintenance and growth. The Department Head should champion these positions to the administration of the institution. In addition, individuals and groups of individuals within the department should champion each position. Where possible, individuals and groups of individuals should look for other mechanisms to obtain positions via alternative streams of funding (e.g., industry chairs, new university or government initiatives).