Geophysics at the University of Alberta: A longstanding and vibrant tradition

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Introduction

Geophysical research at the University of Alberta has a long and rich history, starting in 1954, investigating both applied and fundamental questions such as: Why do the Earth and planets have magnetic fields? Can we forecast earthquakes? What was the climate like in the past? How did plate tectonics form the Rocky Mountains? How do we locate hydrocarbons and other resources underground? Does hydraulic fracturing cause earthquakes? Is geothermal energy an option for Canada? What happens to CO2 stored underground?

The early years: The 1950s

The first geophysics faculty appointment in the Physics Department was George Garland in 1954. The beginning is possibly best told in Garland's own words. Asked why the University of Alberta became interested in Geophysics, Garland said: "I think there had been demand among the students there because Alberta was just beginning to be [in] a very active oil exploration [phase]. Leduc had been found in 1947, seismically, by Imperial Oil. This was 1954. The university should have been into it earlier, but they weren't. The geology department was rather conservative and the physics department had no interest in geophysics. The physics department felt, because students were asking – "Can we study geophysics here?" – there had been a sufficient student inquiry so the physics department decided to take up the challenge and start geophysics rather than the geology department. I was alone for a while and then was gradually part of a larger group."

To place this in historical context, the 1947 Imperial Oil discovery, known as the Leduc No. 1 well, spurred a boom in hydrocarbon exploration and production across Western Canada. Billions of investment dollars flowed to the province of Alberta accompanied by a massive influx of people. The populations of the cities of Edmonton and Calgary doubled in size within 10 years of the discovery, explaining the student requests to be taught geophysics. Also, even though Garland described the geology department as conservative, the Leduc No. 1 discovery is commonly attributed to work by one of its professors and his students. It was Charlie Stelck who postulated that the best place to look for black gold was fossil tropical seashores and reefs,

arguing the Arctic and Western Canada had once been at tropical latitudes, decades before plate tectonics became widely recognized.

Research in Geophysics at the University of Alberta has always been broad, covering both applied and fundamental studies (Table 1). Garland originally focused on gravity and magnetic surveys over the plains to look at structures in the basement, arguing that one could make useful deductions about structures in the sedimentary column based on studies of the basement underneath. Keeva Vozoff joined the Department in 1958, to work on electrical studies of the crust. Vozoff is commonly referred to as the father of 3D electromagnetic modeling, 3D electromagnetic inversion, and joint inversion, based on foundational publications in respectively 1958 (forward modeling), 1960 (inversion) and the 1970s (joint inversion). George Cumming arrived in 1959, with a background in seismic interpretation. Joseph Lipson (in Geology) also connected for several years with the Geophysics group in the late 1950s, building mass spectrometers for geochronology purposes.

The research interests of these researchers often spanned multiple domains. Garland was also interested in mapping the crust using seismic refractions from very large chemical explosions. Cumming also built mass spectrometers for age dating of rocks based on uranium and lead isotopes. Building and designing equipment was an important scientific endeavour, as off-the-shelf equipment rarely existed. Likewise, computer modeling generally started with the question – what are the underlying mathematical equations? – before delving into solving implementation challenges for machines that could occupy an entire room. Photos 1-4 give a glimpse into scientific experimentation, investigations and field work in the 1960s.

Growth: 1960s, 1970s and 1980s

The University of Alberta grew significantly during the late 1960s, and with it the Geophysics group. It also saw the birth of the Institute of Earth and Planetary Physics in 1969. Hiring in the early 1960s increased expertise in stable isotopes (Roy Krouse, 1960), paleomagnetism (Jan Hospers, 1963), and magnetotellurics (David Rankin, 1964). The only new seismologist was Ernest Kanasewich (1963), a former student of George Garland. Kanasewich's MSc thesis work was on gravity surveys on the Athabasca Glacier.

The next ten years would see a real growth spurt, adding additional expertise in magnetotellurics (Ian Gough, 1966; Walter Jones, 1971), paleomagnetism (Dai Jones, 1967; Earl McMurry, 1969; Ted Evans, 1972), core dynamics (Jack Jacobs, 1967), space physics (Gordon Rostoker, 1968), and seismology (Chris Chapman, 1969; Frantisek Hron, 1974; Edo Nyland, 1974).

The Department of Physics certainly knew how to recognize talent. Evans, Garland, Gough, Kanasewich and Rostoker would all become Fellows of the Royal Society of Canada during

their tenure at the University of Alberta. Garland was even elected to the Order of Canada, in a later part of his career, for major contributions to our knowledge of the earth's crust and upper mantle, and of its gravitational fields, and he became the President of the Academy of Science, one of the three Academies comprising the Royal Society of Canada. Jacobs, hired to help build the Killam Department of Earth Sciences and the inaugural director of the Institute of Earth and Planetary Physics, had been elected Fellow prior to joining. Jacobs realized that the Earth's core slowly cools from the center outwards, thus creating the solid inner core. This idea now forms the basis for all modern theories explaining the origin of the Earth's magnetism.

The Geophysics group contributed to many discoveries. For instance, PhD student Ronald Clowes, Ernest Kanasewich and George Cumming would demonstrate in the mid-late 1960s that it is possible to image deep crustal reflectors at depths of 5-60km using near-vertical seismic reflections (instead of the then commonly used far-offset refractions). In the mid 1980s, Ernest Kanasewich and Ronald Clowes (then at UBC) would become co-founders of Lithoprobe, the largest earth science project ever undertaken in Canada. Lithoprobe lasted for over two decades, mapping deep crustal and lithospheric structures throughout Canada. Ronald Clowes was the Director of Lithoprobe for most of its duration.

Ian Gough was one of the other driving forces behind Lithoprobe, as the champion of the non-seismic methods. He and his students helped map crustal and lithospheric structures in North America, South Africa, Scotland and Australia, using magnetometers he co-designed, known as the Gough-Reitzel magnetometers. Ian Gough with J. S. Bell (then at BP Canada) also were the first to recognize that borehole breakout (spalling) in hydrocarbon wells was caused by stress concentrations at the borehole circumference, and that the maximum horizontal stress was oriented perpendicular to the NW trend of the Rocky Mountains in Alberta. The analysis of borehole breakout orientations is now a fundamental tool to reveal crustal stress orientations throughout the world.

Ted Evans is best known for his research in rock magnetism, paleomagnetism and paleoclimatology, demonstrating how rocks record a stable memory of the ancient magnetic field, the strength and direction of that field on time scales from modern to Precambrian, and how the magnetic record can be applied to continental drift, stratigraphic correlation, and variations in global climate. He showed for instance that the early Precambrian geomagnetic field was as strong as today's field and that the core dynamo was therefore in operation early in Earth history. He also demonstrated how the magnetic record in loess and paleosol sequences in China, Siberia and elsewhere can be related to paleotemperature and precipitation and can even record climate events half a globe away.

Gordon Rostoker, on the other hand, decided to look up into the sky, instead of down into the earth. Using arrays of ground-based magnetometers, he monitored the development of the

auroral electrojets, large scale ionospheric electric currents in the ionosphere, and the field-aligned currents that connect them to the generator region in the magnetosphere. These currents are associated with the Northern Lights, thus helping gain new insights into their occurrence. In 1989, the space physics group became part of the Canadian Network for Space Research, one of the first Centres of Excellence established by the Federal Government. The University of Alberta was one of the nodes of the Network, which operated until 1994.

Some other notable contributions include fundamental work by Franta Hron on the seismic modeling method known as asymptotic ray theory. He and his Russian friend/colleague Boris Mikhailenko discovered the so-called S*-wave, for which they were awarded the Russian State Prize. The S* wave is a nongeometric (inhomogeneous) wave which occurs when a P-wave source is placed close to the free surface.

Chris Chapman is another famous proponent of asymptotic ray theory who spent several years in the Geophysics group. Just like Jacobs, Chapman would get the Gold Medal of the Royal Astronomical Society in the United Kingdom for his life-time research achievements.

Meanwhile Edo Nyland and Maurice Dusseault in Engineering were among the first in the early 1980s to monitor microseismic events during in situ (underground) heavy oil production, and to explain their occurrence in terms of geomechanical processes. Microseismic events are acoustic emissions caused by brittle rock failure in their case due to fireflooding of the underground heavy oils. Fireflooding is now mostly superseded by steam injection but consists of injecting hot high-oxygen air into the reservoir after igniting a fire at the reservoir level to mobilize the viscous oils.

Walter Jones, finally, was among the first to model magnetotelluric responses over complex 3-D resistivity structures, and to create a map of the temperatures in the shallow subsurface based on hydrocarbon well measurements.

Hiring continued in the 1980s with John Samson (1980, space physics), Tim Spanos (1980, porous media theory) and after a gap of nearly a decade Doug Schmitt (1989, reflection seismology and rock physics). John Samson strengthened the space physics group, that grew into a separate focus group, currently comprised of Ian Mann (another Fellow of the Royal Society), Richard Marchand, Robert Rankin and Richard Sydora. Space physics has now sent its second student-built satellite into the sky, and is responsible for AuroraWatch, a website generating alerts on the likelihood to see the aurora borealis in the Edmonton area.

Tim Spanos' ideas to use pressure pulses in fluid filled rocks has motivated field studies for enhanced heavy oil recovery and environmental remediation, ultimately leading to the creation of a spin-off company in environmental remediation of contaminated groundwater. Doug Schmitt continued the proud tradition of Kanasewich, Cumming and Gough doing reflection and borehole seismic fieldwork all over the world, and using borehole breakout for stress

determination as part of the Continental Drilling Program. Schmitt also created his own rock physics laboratory, measuring seismic properties of rocks under stress.

Current area: 1990s to present

The early 1990s were a challenging time when then-premier Ralph Klein slashed public spending by about 20 percent, causing university-wide restructuring, and the merging of many departments. Hiring did not resume until Mauricio Sacchi arrived in 1997, starting another decade of growth, in part to replace the many retirements (Cumming, 1994; Kanasewich, 1996; Nyland and Rostoker, 1997; Evans, 1998; Gray, 2000; Jones, 2003), and the unfortunate passing away of Franta Hron in 1998. Next came Moritz Heimpel (1999), Martyn Unsworth (2000), Vadim Kravchinsky (2002), Jeff Gu (2004), Claire Currie, Christian Haas and Bruce Sutherland (2007), Mathieu Dumberry and Mirko van der Baan (2008), and finally David Potter (2009), continuing the group's tradition to hire across all branches of geophysics, covering both applied and fundamental research themes.

- Martyn Unsworth, like Ian Gough, is conducting electromagnetic and magnetotelluric fieldwork all over the world to understand global tectonics and investigate environmental applications;
- Moritz Heimpel and Mathieu Dumberry continue in the footsteps of Jake Jacobs, performing geodynamic studies of the Earth, as well as various planets;
- Vadim Kravchinsky builds on work initiated by Ted Evans, exploring paleomagnetic properties of rock and what they divulge on geology, climate and past environments.
- Jeff Gu helped greatly expand the seismological network in Alberta, and investigates what regional and global earthquakes reveal about the structure of the crust and mantle;
- Claire Currie is modeling mantle/lithosphere dynamics to reveal the processes that shaped the surface of the Earth;
- Bruce Sutherland studies fluid dynamics in the ocean and atmosphere using both laboratory-based experiments and numerical modeling;
- David Potter's interests are in petrophysics, core analysis, rock physics and rock magnetism;
- Mirko van der Baan works in applied seismology, investigating how microseismic monitoring can be used to reveal brittle failure and fracture propagation during underground fluid injection;
- Finally, Christian Haas spent several years in the group (2007-2012). He is a sea ice geophysicist examining the role of sea ice in the climate-, eco- and human systems both in the Arctic and Antarctic.

Full profiles of current faculty can be found at the end of the article.

Interaction with industry and research consortia

The Geophysics group has always interacted extensively with the hydrocarbon industry. Garland already mentions he had “A lot of fun talking with oil companies to get apparatus. We got some seismic gear from oil companies; logistic support. I did heat flow measurements in oil wells in the northwest territories. We got the use of Imperial Oil's airplane to take our equipment and things like this.”

Interaction with industry has always taken a plurality of forms: from in kind contributions (flight time and logistic support, equipment donations, data and software licensing) to financial contributions, and possibly most importantly the exchange of ideas and information. A large percentage of graduates have pursued careers in industry. Various interactions have been formalized via joint-industry projects, also known as research consortia, where industry provides data, software and funding to facilitate research related to specific scientific challenges. Such joint industry projects can be at any scale, from funding for an individual student, to dozens of companies joining a research consortium with a formal structure.

Doug Schmitt created the Seismic Heavy Oil Consortium (SHOC) which ran from the mid 1990s to early 2000s, focusing on the use of time-lapse reflection seismics to monitor changes in heavy oil reservoirs due to steam injection. He and his students would repeatedly acquire seismic reflection data over a heavy oil field to determine the temporal and spatial evolution of the steam front and map viscosity changes of the in situ heavy oils to facilitate reservoir drainage. Schmitt would later become involved in CHORUS, the Consortium for Heavy Oil Research by University Scientists, led by Larry Lines at the University of Calgary, using his rock physics laboratory to measure the physical properties of core samples saturated with heavy oils.

In 2001, Mauricio Sacchi created SAIG, the Seismic Signal Analysis and Imaging Group. The group has been continuously supported by industry and is still going strong, working on a large variety of topics, including signal processing, data regularization and seismic imaging. Multiple developed algorithms, such as 5D data interpolation, are now part of the processing workflows of service companies. The group also stands out for the quality of its students; three of its graduate students (Sam Kaplan, Henning Kuehl and Mostafa Naghizadeh) have received the Clarence Karcher Award of the Society of Exploration Geophysicists, awarded in recognition of significant contributions to the science and technology of exploration geophysics by a young geophysicist of outstanding abilities.

Finally the Microseismic Industry Consortium (MIC) is an applied-research, geophysical initiative jointly founded in 2010 by David Eaton (University of Calgary) and Mirko van der Baan. The name was changed to the Consortium for Distributed and Passive Sensing (C-DAPS) in 2023 to reflect the continuous growth in scope and research themes since its inception. The Consortium works on the advancement of research, education and technological innovations in

microseismic methods and their practical applications for resource development. Microseismic monitoring involves the acquisition of continuous seismic data for the purpose of locating and characterizing seismic activity in nonconventional reservoirs such as tight-gas, tight-oil or heavy-oil fields. Used for decades in the mining industry to monitor deep underground mines, it has emerged as an important tool for monitoring hydraulic fracturing of tight-hydrocarbon reservoirs, steam injection in heavy-oil fields, management of geothermal reservoirs, and establishing the long-term fate of CO_2 stored underground. There are also very strong links with global earthquake seismology where similar techniques have been used to study the structure and geodynamic processes that shape the Earth. In 2019 Eaton, Van der Baan and the Microseismic Industry Consortium were awarded the NSERC Synergy Award for Innovation, in the category “Two or more companies”. This national award recognizes examples of collaboration that stand as models of effective partnership between industry and colleges or universities.

The future

While the main focus of this article is the history and accomplishments of the Geophysics group at the University of Alberta, if you ask what professors are most proud of, the answer is often “the achievements of our students”. It was former students of Charlie Stelck who were behind the discovery made in the Leduc No. 1 well, changing life and prosperity in the Province of Alberta for generations. While this is an achievement that is difficult to beat, the Geophysics group has taught geophysics to well over two thousand students. Together, these students have had a long-lasting impact on society. The Geophysics group will continue to explore unanswered questions in applied and fundamental science, and keep training and educating the next generations of students, thus continuing its mission.

Profiles of current Faculty

Dr. Claire Currie’s research focuses on lithosphere dynamics and convergent plate margins. Dr. Currie and her students use numerical models and geophysical observations to study the upper 300 km of the Earth. Current projects address continental tectonics, subduction zone processes and mountain-building in Western North and South America. Dr. Currie’s research program is particularly interested in understanding the relationship between mantle/lithosphere dynamics and surface observations, such as deformation, topography, basin development and magmatism.

Dr. Mathieu Dumberry’s research is focused on the dynamics of planetary interiors. This includes convective flows in spherical shell geometries, the generation and evolution of planetary magnetic fields, the rotational dynamics of planetary bodies and fluid-solid interactions at interior boundaries. His work uses both theoretical and numerical modelling.

Dr. Yu (Jeff) Gu is a global seismologist interested in all aspects of 3D crustal and mantle structural studies. He is also responsible for launching the Canadian Rockies and Alberta Network (CRANE) seismic array in Alberta. Dr. Gu and collaborators at the Alberta Geological Survey have also been conducting studies in the area of induced seismicity.

Dr. Moritz Heimpel's main research interest is the dynamics of planetary interiors, which involves the theoretical and numerical modelling of deep flow and convection and the generation of global magnetic fields. His group pursues research that addresses current scientific problems in Earth and planetary dynamics. Specific projects have advanced our understanding of the dynamical evolution of several of solar system planets, particularly those of Mercury, Earth, Jupiter, Saturn, Uranus and Neptune, as well as exoplanets.

Dr. Vadim Kravchinky studies magnetic properties of sedimentary and igneous rocks and their implications for understanding geological, climatological and environmental changes. His other areas of research interest include archeological geophysics and climate modelling. Dr. Kravchinsky directs the laboratory of paleomagnetism and petromagnetism at the University of Alberta.

Dr. David Potter's research program is in the areas of petrophysics, core analysis, rock physics, rock magnetism and nano-magnetism. He uses magnetic and other rock physics techniques to determine mineral contents, fluid flow and other properties, for a range of geophysical and petrophysical applications. He received the Darcy Award in 2015 for lifetime technical achievement from the Society of Core Analysts. Dr. Potter has a joint appointment with the Department of Earth and Atmospheric Sciences. He was also the inaugural Director of the Integrated Petroleum Geosciences (IPG) professional MSc program at the University of Alberta, a joint program between the Departments of Physics and Earth and Atmospheric Sciences.

Dr. Mauricio Sacchi's research program includes the area of statistical and transform methods for seismic data processing, waveform imaging and inversion in applied and global seismology. Dr. Sacchi directs the Signal and Imaging Group (SAIG), a consortium for advanced research in seismic data processing and imaging. The group has become recognized for developing algorithms for multi-dimensional seismic data reconstruction, de-noising and for application of sparsity promoting methods for solving seismic processing problems.

Dr. Bruce Sutherland's research focuses on the dynamics of the atmosphere and oceans, particularly as they are affected by density variations. This includes the study of waves, plumes and currents. Recent work has begun to explore particles in fluid flow, including the dispersion of ash from volcanic eruptions and the transport and deposition of sediments from river plumes, turbidity currents and shoaling internal solitary waves. Dr. Sutherland has a joint appointment with the Department of Earth and Atmospheric Sciences.

Dr. Martyn Unsworth has a wide range of research interests that includes magnetolluric exploration in a range of pure and applied studies. His group has carried out magnetotelluric fieldwork in many parts of Canada with studies focussed on defining the structure of the lithosphere on a continental scale, searching for geothermal and mineral resources, and improving our understanding of earthquake and volcano hazards. Overseas he has studied volcanoes in Antarctica, Argentina, Bolivia, Chile, Iceland and elsewhere, and studied tectonics processes and their links to earthquake hazards in China, Taiwan and Turkey. Dr. Unsworth has a joint appointment with the Department of Earth and Atmospheric Sciences.

Dr. Mirko van der Baan's research interests are in the intersection of signal processing for reflection and microseismic data. He is also interested in the study of geomechanical models and microseismic monitoring. Much of Dr. Van der Baan's research is directed by the Microseismic Industry Consortium (co-hosted with the University of Calgary), which covers all aspects of microseismic research from acquisition, processing to interpretation. Dr. Van der Baan is one of founding members of the Integrated Petroleum Geosciences (IPG) professional MSc program at the University of Alberta. Van der Baan was the 2017 Honorary Lecturer, North America, for the Society of Exploration Geophysicists: "How widespread is human-induced seismicity in North America?".

Acknowledgments

I would like to thank Janis Rose for inviting me to write this article. I greatly enjoyed discovering the history and accomplishments of the Geophysics group at the University of Alberta over close to 70 years. It is unlikely I would have dug into this without her invitation. Doug Schmitt wrote an earlier version of the history of the Geophysics group which was a tremendous help. Suzette Chan kindly verified the appointment dates. John Beamish provided the historic photographs, and both John Beamish and Ted Evans were able to identify photo contents. Thanks also to all members of the geophysics research area at the Department of Physics, University of Alberta, for providing input for this article.

Sources (References)

This article builds on an earlier historic overview written by Doug Schmitt (CSEG Recorder, March 2003), which has been expanded using a variety of sources including interviews, award speeches, memorials, wikipedia and the SEG wiki. Staff profiles have been updated from another overview article by Mauricio Sacchi (CSEG Recorder, September 2014).

Cumming: https://wiki.seg.org/wiki/George_Cumming

Garland: https://www.aip.org/history-programs/niels-bohr-library/oral-histories/24364

Gough: http://www.mtnet.info/memoriam/gough.html

Hron: https://library.seg.org/doi/pdf/10.1190/tle18010138.1

Jacobs: https://doi.org/10.1046/j.1468-4004.2003.45534.x

Kanasewich: https://wiki.seg.org/wiki/Ernest_Kanasewich

Rostoker: https://doi.org/10.3389/fspas.2022.912036

Vozoff: https://wiki.seg.org/wiki/Keeva_Vozoff

Stelck: https://www.ualberta.ca/science/news/2016/may/celebrating-the-life-of-charlie-stelck.html

While Charlie Stelck was not a geophysicist (we won't hold it against him), his achievements and life story are remarkable. I once met him when he was already in his 90s. He gave me the advice "never allow yourself to be boxed in", meaning you should always strive to explore new topics, learn new fields, be open minded, and reinvent yourself if your career or outlook becomes stagnant.

For those interested in an early history of the University of Alberta (from inception till mid 1950s): https://sites.ualberta.ca/ALUMNI/history/founding/53winhist.htm

Table 1. The composition of the Geophysics group at the University of Alberta since inception. Most appointments are with the Department of Physics, but cross- or full appointments with the Department of Earth and Atmospheric Sciences, including its predecessors, are not uncommon. For instance, Lipson was in the Department of Geology, and Jacobs was hired to help build the newly formed Killam Department of Earth Sciences.

Faculty Member	Specialization	Years
George Garland	Gravity	1954-1963
Joseph Lipson	Geochronology	1957-1961
Keeva Vozoff	Magnetotellurics	1958-1965
George Cumming	Seismology/Geochronology	1959-1994
Roy Krouse	Stable Isotope	1960-1974
Jan Hospers	Paleomagnetism	1963-1965
Ernest Kanasewich	Seismology	1963-1996
David Rankin	Magnetotellurics	1964-1982
Ian Gough	Magnetotellurics, Stress	1966-1987
Jack Jacobs	Core Dynamics	1967-1975
Dai Jones	Paleomagnetism	1967-1968

Gordon Rostoker	Space Physics	1968-1997
Chris Chapman	Theoretical Seismology	1969-1975
Earl McMurry	Paleomagnetism	1969-1972
Walter Jones	Magnetotellurics, Geothermics	1971-2003
John Gray	Stable Isotopes	1972-2000
Ted Evans	Paleomagnetism	1972-1998
Frantisek Hron	Theoretical Seismology	1974-1998
Edo Nyland	Seismology	1974-1997
John Samson	Space Physics	1980-2006
Tim Spanos	Porous Media Theory	1980-2005
Douglas Schmitt	Applied Seismology, Rock Physics	1989-2018
Mauricio Sacchi	Seismic Imaging and Inversion	1997
Moritz Heimpel	Geodynamics	1999
Martyn Unsworth	Magnetotellurics	2000
Vadim Kravchinsky	Paleomagnetism	2002
Jeffrey Gu	Global Seismology	2004
Claire Currie	Geodynamics	2007
Christian Haas	Sea Ice Geophysics	2007-2012
Bruce Sutherland	Fluid Dynamics	2007
Mathieu Dumberry	Geodynamics	2008
Mirko van der Baan	Applied Seismology and Signal Processing	2008
David Potter	Petrophysics, Rock Physics, Rock Magnetism	2009

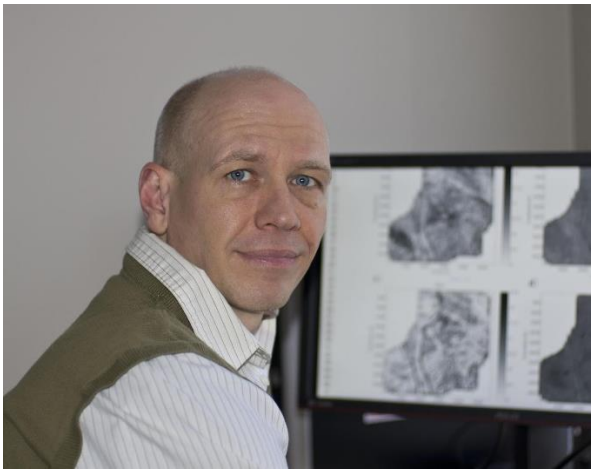
Photo 1. Mass spectroscopy lab, Physics, 1960s. Mass spectroscopes were originally developed to resolve questions about the fundamental nature of the atom. Geochronology establishes the age of rocks based on the measurement of isotopic ratios by mass spectrometry. Photo Courtesy: Department of Physics, University of Alberta.

Photo 2. Geophysics field trucks, 1967, parked in front of the original Physics building, University of Alberta, North Campus. The Department of Computing Science, created in 1964, shared the building with the Department of Physics until 1968. The Physics Building was later renamed the Avadh Bhatia Physics Building in honor of one of its professors, then demolished to make way for the Centennial Centre for Interdisciplinary Science (which opened in 2011). The circles are radio antennas, possibly to communicate with equipment in the field. Photo Courtesy: Department of Physics, University of Alberta.

Photo 3. G.S. Murthy operating the spinner magnetometer in the Palaeomagnetic Lab in the old Physics Building (photo 2). Murthy may have been the first Ph.D out of this Lab. He then moved to Memorial University of Newfoundland (MUN). Photo Courtesy: Department of Physics, University of Alberta.

Photo 4. Seismological investigations in 1962. So far we have been unable to identify the people in this picture but the person on the far right could be a young George Garland. Any insights would be appreciated if you happen to recognize the persons. Photo Courtesy: Department of Physics, University of Alberta.

About the Author



Mirko van der Baan *is a professor at the University of Alberta in the Department of Physics, specializing in Applied Seismology. He graduated in 1996 from the University of Utrecht in the Netherlands, obtained a PhD with honors in 1999 from the Joseph Fourier University in Grenoble, France, and then joined the University of Leeds, UK, where he became the Reader of Exploration Seismology. He also holds an HDR (Habilitation) from University Denis Diderot, Paris, France.*