**THE UNIVERSITY OF BRITISH COLUMBIA**

***Curriculum Vitae for Faculty Members***

**Date: August 2020** (updated). [Some UBC sections removed or shortened to limit length of CV]

**1.** **SURNAME**: CLOWES **FIRST** **NAME**: Ronald

**MIDDLE NAME(S)**: Martin

**2.** **DEPARTMENT/SCHOOL:** Earth, Ocean & Atmospheric Sciences

**3.** **FACULTY**: Science

**4.** **PRESENT RANK**: Professor Emeritus **SINCE**: July 1, 2007

**5.** **POST-SECONDARY EDUCATION**

**University or Institution Degree Subject Area Dates**

University of Calgary Physics 1960-1962

University of Alberta B.Sc. (Hon.) Physics 1962-1964

University of Alberta M.Sc. Geophysics 1964-1966

University of Alberta Ph.D. Geophysics 1966-1969

**6. EMPLOYMENT RECORD**

*(a) Prior to coming to UBC*

**University, Company or Organization Rank or Title Dates**

Australian National University, Canberra,

Department of Geophysics & Geochemistry Honorary Research Fellow 1969-1970

*(b) At UBC*

**Rank or Title Dates**

Assistant Professor August 15, 1970

Associate Professor July 1, 1977

Professor July 1, 1983 – June 30, 2007

Director, LITHOPROBE May 1987 – March 2005

Professsor Emeritus July 1, 2007 – present

*(c) Date of granting of tenure at U.B.C.:* July 1, 1975

**7. LEAVES OF ABSENCE**

**University, Company or Organization**

**at which Leave was taken Type of Leave Dates**

University of British Columbia and Swiss Federal Sabbatical July 1, 2006 to

Institute of Technology, Zurich, Switzerland June 30, 2007

University of British Columbia Administrative leave July 1, 2003 to

June 30, 2004

Institute of Geophysics, Copenhagen University, Study leave as Visiting July 1, 1979 to

Copenhagen; and Laboratory for Geophysics, Associate Professor June 30, 1980

Aarhus University, Aarhus, Denmark

**8. TEACHING**

*(a) Areas of special interest and accomplishments*

Exploration Geophysics: development of lectures and laboratories for GEOP 321 (Seismology) and GEOP 421 (Applied Geophysical Laboratory); to 1987. After being appointed as Director of Lithoprobe in May 1987, I was seconded from teaching responsibilities at UBC. In 2001-02, I returned to a 50% position in EOS and resumed teaching. In 2003-04, I was on administrative leave. As the recipient of a Canada Council for the Arts Killam Research Fellowship for 2004-2006, I was relieved from teaching.

*(b) Courses Taught at UBC* [Information deleted]

*(c) Graduate Students Supervised*

**Student Name Program Type Year Principal Co-Supervisor(s)**

**Start Finish Supervisor**

Aimee Bertrand M.Sc. 1970 1972 R.M. Clowes

Geoffrey Bennett M.Sc. 1971 1973 R.M. Clowes R.M. Ellis

G.J. Pareja M.Sc. 1975 R.M. Ellis R.M. Clowes

Stanislav Knize Ph.D. 1970 1976 R.M. Clowes

George Spence M.Sc. 1976 R.M. Clowes R.M. Ellis

Steven Malecek M.Sc. 1973 1976 R.M. Clowes

Steven Lynch M.Sc. 1975 1977 R.M. Clowes

William Cumming M.Sc. 1974 1977 R.M. Clowes

Allan Thorleifson M.Sc. 1976 1978 R.M. Clowes

Henry P.Y. Cheung M.Sc. 1976 1978 R.M. Clowes

Shlomo Levy M.Sc. 1979 R.M. Clowes

Daniel Au Ph.D. 1981 R.M. Clowes

D. Neil Bird M.Sc. 1981 R.M. Clowes R.M. Ellis

James R. Horn M.Sc. 1982 R.M. Clowes R.M. Ellis

David A. Waldron M.Sc. 1982 R.M. Clowes

Donald White M.Sc. 1983 R.M. Clowes

Julian J. Cabrera M.Sc. 1983 R.M. Clowes D.W. Oldenburg

George D. Spence Ph.D. 1984 R.M. Clowes R.M. Ellis

Ian F. Jones Ph.D. 1985 R.M. Clowes R.M. Ellis

David A. Mackie M.Sc. 1985 R.M. Clowes

Sonya Dehler M.Sc. 1986 R.M. Clowes

Chris J. Pike M.Sc. 1986 R.M. Clowes

Jeff J. Drew M.Sc. 1987 R.M. Clowes

Constance R. Cudrak M.Sc. 1988 R.M. Clowes

Donald J. White Ph.D. 1985 1989 R.M. Clowes

Elizabeth Hasselgren M.Sc. 1987 1991 R.M. Clowes [Includes 1 yr. employment]

Sonya A. Dehler Ph.D. 1986 1991 R.M. Clowes

Deirdre M. O’Leary M.Sc. 1990 1992 R.M. Clowes

John A. Hole Ph.D. 1986 1993 R.M. Clowes

Michael J. Perz M.Sc. 1990 1993 R.M. Clowes

Weimin Zhang M.Sc. 1992 1997 R.M. Clowes [incl. 1.5 yr employment]

Carl Wang M.Sc. 1992 1997 R.M. Clowes [incl. 2.5 yr employment]

Denise Long M.Sc. 1994 1998 R.M. Clowes R.M. Ellis

[incl. 0.5 yr employment]

Kim Welford M.Sc. 1997 1999 R.M. Clowes

Andrew Gorman Ph.D. 1994 2000 R.M. Clowes

Kate Bone M.Sc. 1999 2002 L. Kennedy R.M. Clowes

Kim Welford Ph.D. 2000 2004 R.M. Clowes

Alastair McClymont M.Sc. 2002 2004 R.M. Clowes

Jounada Oueity Ph.D. 2003 2010 R.M. Clowes

David Moore M.A.Sc. 2005 2008 R.M. Clowes

Soo-Kyung Miong M.Sc. 2005 withdrew R.M. Clowes

Vishal Kumar M.Sc. 2006 2009 F. Herrmann R.M. Clowes

Brendan Smithyman Ph.D. 2007 2013 R.M.Clowes

*(d) Continuing Education Activities*

*(e) Visiting Lecturer (indicate university/organization and dates)*

*(f) Other*

Postdoctoral Fellows:

Eva Gens-Lenartowicz, 1982-85: Ph.D., Moscow, USSR

Andrew J. Calvert, 1987-90: Ph.D. (1985), Cambridge University, U.K.; awarded U.B.C. Killam Postdoctorate Fellowship (1987-89).

Phil Hammer, 1992 - 1994: Ph.D. (1991), Scripps Institution of Oceanography, UCSD, San Diego, CA; awarded NSERC Postdoctoral Fellowship.

David Baird, 1994 - 1996: Ph.D. (1994), Cornell University, Ithaca, NY.

Holger Mandler, 1995 - 1998: Ph.D. (1995), Alfred Wegener Institute, University of Bremen, Bremerhavn, Germany; awarded DAAD and DGF Postdoctoral Fellowships from Germany.

Gabriela Fernandez Viejo, 1997 - 1999: Ph.D. (1997), University of Barcelona, Barcelona, Spain; awarded Postdoctoral Fellowship from Spain.

Baishali Roy, 1997 - 1999: Ph.D. (1997), University of Western Ontario, London.

Kumar Ramachandran, 2002 - 2003: Ph.D. (2001), University of Victoria, B.C.

Kim Welford, 11/2004 - 6/2005: Ph.D. (2004), UBC

Research Associates

Phil Hammer, 1995 - 2011: Ph.D. (1991), Scripps Institution of Oceanography, UCSD, San Diego, CA.

Gabriela Fernandez Viejo, 2002 - 2003: Ph.D. University of Barcelona, Barcelona, Spain.

### Visiting Scientists

Ms. Martina Demartin, Instituto per la Geofisica della Litosfera, Reparto Geofisica Applicato, Milano, Italy - 1985, 8 months.

Dr. Josep Muñoz, Geological Survey of Barcelona, Barcelona, Spain - 1988, 4 months.

**9. SCHOLARLY AND PROFESSIONAL ACTIVITIES**

*(a) Areas of special interest and accomplishments*

**Research areas of interest:**

The general objective of my research programs is a more complete understanding of the present structure and past evolution of the lithosphere of the North American continent and continental margins, and the geotectonic processes associated with that evolution, through seismic reflection, refraction/wide-angle reflection (R/WAR) and related geophysical studies. This objective is achieved by (1) specific projects in characteristic regions of Canada which generally include field acquisition of data, and analysis and interpretation of these and related data (including concurrent development of new methodologies as necessary); (2) integration of these geophysical results with geological and other geophysical information; and (3) syntheses and comparisons of results and information from a range of such studies. As Director of Lithoprobe, I have enjoyed the opportunity to expand both my interests and my knowledge in earth sciences, particularly as they relate to the Canadian landmass and offshore margins. As such, my geological areas of interest have expanded from offshore west coast and British Columbia to most regions of Canada. Lithoprobe provides the framework within which much research related to these interests has been possible for the past 20 years.

**Major accomplishments [with students, postdoctoral fellows and colleagues]:**

My U.B.C. controlled-source seismic group established a world-class marine seismic program to investigate geological structures off the west coast of Canada (1971-1989). The initial reflection and refraction program included a sonobuoy system (free drifting) and hydrophone system cabled to a receiving ship; the controlled sources were explosive charges. Subsequently, the R/WAR program expanded to include ocean bottom seismographs with 3-component geophone plus hydrophone recording and using airguns as the seismic source. Among some of our accomplishments, (1) we carried out the first seismic refraction tomography experiment across an oceanic spreading center (the Juan de Fuca Ridge), prior to similar studies by Woods Hole Oceanographic Institute, Woods Hole, MA and Scripps Institution of Oceanography, La Jolla, CA; and (2) analysis of both P- and S-wave arrivals from OBS studies over the Juan de Fuca plate provided the first in-situ confirmation of upper mantle anisotropy predicted from laboratory studies of ophiolite samples (oceanic lithosphere obducted and now emplaced on land) and enabled evaluation of Poisson's ratio with depth in the oceanic crust.

We carried out the first detailed R/WAR and reflection study across an active subduction zone, delineating characteristics of the subducting plate, the overriding plate and the boundary between them. The refraction work led to a new ray tracing interpretation procedure, which was distributed to about 50 institutions worldwide. The combined reflection/refraction studies extending landward above the subducting plate are still widely referenced. Based on this research, follow-up work by scientists at the Geological Survey of Canada, Pacific in Sidney, BC has defined much more clearly the seismic hazard on the west coast from a megathrust earthquake. An offshore-onshore study in the Queen Charlotte Basin provided new information about the basin and led to the development of a new approach for analysis (based on finite-difference procedures) by my Ph.D. student, a technique that was developed further by him and other scientists.

Research through Lithoprobe has focussed on regions of the southern and northern Cordilleras, the Trans-Hudson Orogen, the Slave province-Wopmay orogen and the crystalline basement beneath the Western Canada Sedimentary Basin. In all these regions, we have provided exciting new information and results, which have modified or clarified prevailing views of tectonic development. As Director and as an active scientist, I believe that I have contributed substantially to the new and outstanding results achieved in these regions and to the international recognition of Lithoprobe as the pre-eminent project for the study of the continental lithosphere in the world.

In the early 2000s, we accomplished a unique research experiment – seismic reflection techniques were applied, for the first time, to image a thin (1-5 m), diamondiferous kimberlite dyke from subcrop to depths >1300 m. The project was instigated after inquiries and discussions with two diamond companies. The technical problem of imaging such a thin body is non-trivial. Our approach was to carry out a theoretical study to determine feasibility and optimal parameters, obtain physical properties values from drillcore samples, carry out a survey with appropriate parameters, carefully process the data to provide an image of the dyke and compare this image with drill hole results. We were spectacularly successful; the dyke was imaged exceedingly well such that topography on it and lateral variations within it could be discerned. Two papers and many conference presentations (invited and contributed) highlight our results. The success of this research is well recognized within the diamond industry and has led to one further field survey by one company and plans for follow-up seismic studies by both companies. We have introduced a new exploration tool for specific types of kimberlite bodies.

*(b) Research or equivalent grants (indicate under COMP whether grants were obtained competitively (C) or non-competitively (NC))* [1998-99 to 2012-13].

**Granting Subject $ Year Principal Co-Investigator(s)**

**Agency COMP Per Year Investigator**

NSERC Research Seismic reflection, refraction C 100,100 1998-99 R.M. Clowes

Individual and other geophysical studies   
 of lithospheric structure

NSERC Seismic data enhancement NC 22,424 1998-99 R.M. Clowes

Lithoprobe and analysis for THOT

1994 reflection survey

NSERC Industrially Enhanced imaging of C 19,212 1998-99 R.M. Clowes

Oriented Research Guichon Creek Batholith, BC,

to delineate structures hosting

porphyry copper deposits

NSERC Research Lithoprobe Phase V: The C 4,000,000 1998-99 R.M. Clowes

Networks Evolution of a Continent [on behalf of

Revealed Lithoprobe researchers]

NSERC Research Seismic reflection, refraction C 105,105 1999-2000 R.M. Clowes

Individual and other geophysical studies

of lithospheric structure

NSERC Hardware upgrade for the NC 31,493 1999-2000 R.M. Clowes

Lithoprobe UBC Lithoprobe seismic

Remote site

NSERC Research Lithoprobe Phase V: The C 3,805,000 1999-2000 R.M. Clowes

Networks Evolution of a Continent [on behalf of Lithoprobe

Revealed researchers

NSERC Research Seismic reflection, refraction C 89,700 2000-01 R.M. Clowes

Individual and other geophysical studies

of lithospheric structure

NSERC Research Lithoprobe Phase V: The C 1,300,000 2000-01 R.M. Clowes

Networks Evolution of a Continent [on behalf of Lithoprobe

Revealed researchers]

Winspear Investigation of feasibility NC 35,000 2000-01 R.M. Clowes

Resources & parameters for a seismic

reflection survey of a

kimberlite dyke in the

# Snap Lake region, NWT

NSERC Research Seismic reflection, refraction C 89,700 2001-02 R.M. Clowes

Individual and other geophysical studies

of lithospheric structure

NSERC RPP Mapping kimberlite dykes in C 54,850 2001-02 R.M. Clowes

Collaborative R & D the Snap Lake region, NWT

with seismic reflection

technology – a unique

experiment

Diamondex Resources To establish whether the NC 403,740 2001-02 R.M. Clowes

& DeBeers Canada kimberlite dyke can be

Mining mapped through application

of the seismic reflection

method

NSERC Lithoprobe Software upgrade for the NC 12,800 2001-02 R.M. Clowes

UBC Lithoprobe seismic

remote site

NSERC Research Lithoprobe Phase V: The C 640,000 2001-02 R.M. Clowes

## Networks Evolution of a Continent [on behalf of Lithoprobe

Revealed researchers]

NSERC Research Seismic reflection, refraction C 89,700 2002-03 R.M. Clowes

Individual and other geophysical studies

of lithospheric structure

NSERC RPP Mapping kimberlite dykes in C 47,280 2002-03 R.M. Clowes

Collaborative R & D the Snap Lake region, NWT

with seismic reflection

technology – a unique

experiment

Diamondex Resources To establish whether the NC 0 2002-03 R.M. Clowes

& DeBeers Canada kimberlite dyke can be 4,700 2003-04

Mining mapped through application

of the seismic reflection

method

NSERC Lithoprobe; SNORCLE Transect: Extending NC 30,000 2002-2003 R.M. Clowes

Line 2A westward; quantitative

analyses of seismic reflections

NSERC Research Lithoprobe Phase V: The C 585,000 2002-03 R.M. Clowes

## Networks Evolution of a Continent [on behalf of Lithoprobe

Revealed researchers]

NSERC Research Seismic reflection, refraction C 89,700 2003-04 R.M. Clowes

Individual and other geophysical studies

of lithospheric structure

NSERC CRO BATHOLITHS: Generation & C 0 2003-04 R.M. Clowes

Grant evolution of crust in continental 188,880 2004-05

magmatic arcs 79,740 2005-06

78,200 2006-07

NSERC RPP Mapping kimberlite dykes in C 18,000 2003-04 R.M. Clowes

Collaborative R & D the Snap Lake region, NWT

with seismic reflection

technology – a unique

experiment

Diamondex Resources To establish whether the NC 4,700 2003-04 R.M. Clowes

& DeBeers Canada kimberlite dyke can be

Mining mapped through application

of the seismic reflection

method

NSERC Lithoprobe SNORCLE Transect: Extend- NC 10,500 2003-04 R.M. Clowes

Ing Line 2A westward; quanti-

tative analyses of seismic

reflections

NSERC Research Lithospheric structure derived C 99,180 2004-05 R.M. Clowes

Individual from seismic reflection,

refraction and other geophysical

studies

NSERC CRO BATHOLITHS: Generation & C 188,880 2004-05 R.M. Clowes

Grant evolution of crust in continental 79,740 2005-06

magmatic arcs 78,200 2006-07

NSERC Research Lithospheric structure derived C 99,180 2005-06 R.M. Clowes

Individual from seismic reflection,

refraction and other geophysical

studies

NSERC CRO BATHOLITHS: Generation & C 44,140 2005-06 R.M. Clowes

Grant evolution of crust in continental 220,980 2006-07

magmatic arcs 81,700 2007-08

NSERC Research Lithospheric structure derived C 99,180 2006-07 R.M. Clowes

Individual from seismic reflection, 99,180 2007-08

refraction and other geophysical 99,180 2008-09

studies

NSERC CRO BATHOLITHS: Generation & C 50,140 2006-07 R.M. Clowes

Grant evolution of crust in continental 11,000 2007-08

magmatic arcs

Geoscience BC Enhanced velocity structure from C 20,967 2008-09 R.M. Clowes

waveform tomography of seismic 20,967 2009-10

first-arrival data: Application to

Nechako Basin

NSERC Research Lithospheric structure and tectonics C 63,600 2009-10 R.M. Clowes

based on seismic reflection, refraction 43,200 2010-11

and other geophysical studies 43,200 2011-12

[Final NSERC grants; funded as 14,500 2012-13

as requested]

*(c) Research or equivalent contracts (indicate under COMP whether grants were obtained competitively (C) or non-competitively (NC). [last 10 years only]*

*(d) Invited Presentations*

Recent keynote or invited lectures at conferences [since 2002]:

October 2013 International Meeting on Precambrian Evolution and Deep Exploration of the Continental Lithosphere, Beijing, China. Title: “*LITHOPROBE*: Benefits of the Canadian multidisciplinary Earth science project & relevance for *SINOPROBE”.* Full expenses paid.

October 2013 International Meeting on Precambrian Evolution and Deep Exploration of the Continental Lithosphere, Beijing, China. Title: “Seismic probing and geology: An essential combination illustrated by 30 Years of *LITHOPROBE* interpretations”. Full expenses paid.

November 2011 International Symposium on Deep Exploration into the Lithosphere, Beijing, China. Title: “The application of high resolution seismic reflection studies to mineral exploration Full expenses paid.

November 2011 International Symposium on Deep Exploration into the Lithosphere, Beijing, China. Title: “A lithospheric cross section of the North American continent: Scientific, economic and social benefits of the Canadian *LITHOPROBE* project”. Full expenses paid.

June 2007: GAC NUNA conference on “The pulse of the Earth and planetary evolution”, Sudbury, Ontario. Title: “Seismic imaging of magmatic underplates and intrusions: Results from *LITHOPROBE*”.

June 2006: GSA Penrose conference on “When did plate tectonics begin?”, Lander, Wyoming. Title: “Seismic evidence for Paleoproterozoic and Archean plate tectonic structures”.

February 2006: EarthScope GeoFrame 2006, NSF-sponsored meeting, St. Louis, Missouri. Title: “EarthScope and the GeoFramework concept – Lessons from Lithoprobe”; all expenses paid.

September 2005: EarthScope in the Northern Rockies, NSF-sponsored workshop, Bozeman, Montana. Title: “The Lithoprobe Experience: Active-source seismology and other Earth Science – An essential combination for understanding tectonic evolution”; all expenses paid.

October 2004 4th World Conference of Science Journalists. Montreal, QC. Invited presentation in series "Breaking Science News Press Conference". Title: "A new view of the continent beneath our feet - Lithoprobe's scientific, economic and social contributions."

September 2004: Geoscience Summit 2004. Ottawa, ON. Title: "Lithoprobe - Lessons and benefits from a successful megaproject".

June 2004: Incorporated Research Institutes for Seismology 20th Annual workshop. Tucson, AZ. Title: "Reflection, refraction and teleseismic imaging of the lithospheric mantle: A Lithoprobe view of upper mantle heterogeneity"; all expenses paid.

February 2004: Symposium on Seismic heterogeneity in the Earth's mantle. Copenhagen, Denmark. Title: "Seismic reflection images of the upper mantle from the Canadian Lithoprobe project: Implication for fine-scale heterogeneity"; partial expenses paid.

August 2002: Remote Views and Exploration of Antarctic Lithosphere Workshop (NSF funded), Denver, CO. Title: "Canada's Lithoprobe project: Multidisciplinary transect studies of Precambrian regions"; all expenses paid.

May 2002: John Lewry Symposium, GAC/MAC Annual meeting, Saskatoon, SK. Title: "Crustal structure and tectonic development of the western Trans-Hudson Orogen and Hearne Wyoming craton".

Recent invited lectures, separate from conferences [since 2002]:

Apr 2013 Two seminars, University of Oklahoma, Norman; full expenses paid. Title 1: “A new view of the continent beneath our feet – Lithoprobe’s transcontinental lithospheric cross section”. Title 2: “Snap Lake seismic survey: The first *exploration-scale* seismic reflection survey to successfully image a thin, diamondiferous, kimberlite dyke”.

2008-09 CSEG Distinguished Lecture Tour: ~ 30 requests for presentations from universities and other organizations. Title: “A new view of the continent beneath our feet – Lithoprobe’s scientific, economic and social contributions”. Full expenses paid.

Apr 2008 Invited presentation at the special Alan Green Symposium, ETH Zurich, Switzerland.

The invited presentation, “The Canadian Lithoprobe project – Multidisciplinary Earth science studies reveal the evolution of a contintent”, was made at a number of institutions and organizations:

Jan 2007 Department of Geology, University of Oviedo, Oviedo, Spain; full expenses paid.

Nov 2006 Eotvos Lorand Geophysical Institute and Hungarian Geophysical and Geological societes, Budapest, Hungary; local expenses paid.

School of Cosmic Physics, Dublin Institute for Advanced Studies, Dublin, Ireland; full expenses paid.

Oct 2006 Department of Earth Sciences, Swiss Federal Institute of Technology, Zurich, Switzerland

The invited presentation, “High-resolution seismic reflection imaging of a thin, diamondiferous kimberlite dyke – A case history”, was made at two universities:

Jan 2007 Department of Geology, University of Oviedo, Oviedo, Spain; full expenses paid.

Nov 2006 Applied and Environmental Geophysics Group, Institute of Geophysics, Swiss Federal Institute of Technology, Zurich, Switzerland.

Dec 2006 Colloquium, Institute of Geophysics, Swiss Federal Institute of Technology, Zurich, Switzerland. Title: "The *Lithoprobe* SNORCLE Transect: Geophysical results across 4 Ga of Earth history in northwestern Canada”.

Nov 2006 Colloquium, Department of Earth Sciences, University of Mainz, Mainz, Germany. Title: “Seismic studies in the Canadian Lithoprobe project: Evidence for plate tectonics in the Paleoproterozoic and Archean eras”; full expenses paid.

Sept 2006 Colloquium, Department of Earth & Ocean Sciences, UBC. Title: “*Lithoprobe:* Collaborative, multidisciplinary studies reveal the evolution of a continent ─ A template for future Earth Science megaprojects?”

February 2005 Korean universities and related organizations. Four lectures as special invitee of Seoul National University and the Korean Crustal Seismic Project; full expenses paid for the week-long visit.

April, 2004 Lew Parker Lecturer at Colorado College, Colorado Springs. Two lectures: (1) Lithoprobe - Multidisciplinary Earth science studies reveal the evolution of a continent; (2) Seismic reflection imaging of diamondiferous kimberlite dykes in NWT: A unique experiment; full expenses paid.

January, 2004 Collins Lecturer at Carleton University, Ottawa, ON. Topic: Lithoprobe: Multidisciplinary Earth science studies reveal the evolution of a continent; all expenses paid.

June-July, 2003 Japan universities and other organizations. Seven talks on various subjects under the sponsorship of a fellowship from the Japan Society for the Promotion of Science; full expenses paid for the 4-week visit.

November, 2002 Finland Lithospheric Program Biannual Meeting, Special International speaker. Title: “Crustal growth and recycling: an overview of Lithoprobe results”; full expenses paid.

November, 2002 Department of Geosciences, Oulu University, Oulu, Finland. Title: “Deep structure and seismic reflection studies in Precambrian mining regions: Examples from the Canadian Lithoprobe project”; full expenses paid.

September, 2002 Europrobe Meeting, Stockholm, Sweden. Title: “Crustal growth and recycling: an overview of Lithoprobe results”; all internal expenses paid.

April 2002: University of Wyoming, Laramie, WY. Title: "Crustal growth and recycling – an overview of Lithoprobe results"; partial expenses paid.

*(e) Other Presentations (since 2000) [\* denotes presenter]*

Many submitted conference presentatiatons with students and postdoctoral fellows; list deleted.

*(f) Other [Short Courses Presented]*

October 2013 SINOPROBE and Chinese Academy of Geological Sciences, Beijing, China. 2-day short course given by Prof. An Yin, UCLA, Los Angesles, CA; and me. I gave 6 presentations over the 2 days and participated in much discussion.

April 2011 SINOPROBE and Chinese Academy of Geological Sciences, Beijing, China. 3-day short course given by Dr. Walter Mooney, USGS, Menlo Park, CA; Prof. Alfred Kröner, Univ. of Mainz, Mainz, Germany; and me. I gave 9 presentations over the 3 days and participated in much discussion..

September 2001: Chinese Academy of Geological Sciences, Beijing, China. 22 hours of lectures on Lithoprobe over 5 days; all expenses paid.

*(g) Conference Participation (Organizer, Keynote Speaker, etc.)*

National and international conferences and symposia organized: [Since 1999 only]

2004: Organizer and Keynote Speaker, Lithoprobe Celebratory Conference: From parameters to processes - Revealing the evolution of a continent, October 12 - 15, Toronto, ON.

2003 Co-convenor, with D. Gee (convenor, Sweden), S. Daly (U.K.), I. Kukkonen (Finland), S. Gregersen (Denmark), W. Rabbel (Germany) and S. Hjelt (Finland). Special Session TS3 – The deep structure of continents: focus on results from Europrobe and Lithoprobe, at the Joint Meeting of the European Union of Geosciences, American Geophysical Union and European Geophysical Society, April 5-11, Nice, France.

2003 Convenor with co-covenor P.T.C. Hammer (UBC). Special Session 22 – 4 Billion years of tectonic evolution in NW Canada: Lithospheric lessons from multidisciplinary studies, at the Annual Meeting of the Geological Association of Canada, May 25-28, Vancouver.

1999 Convenor, with co-convenors P. Candela (U.S.A.), S. Maschenkov (Russia) and L. Pedersen (Sweden) of joint symposium JSS44, "Structure of the continental lithosphere from integrated geophysical geological and geochemical studies", at the quadrennial meeting of the International Union of Geology and Geophysics, July 18-30, 1999, Birmingham, England.

1999 Co-convenor with R. England (U. of Cambridge, England), R. Hobbs (U. of Cambridge, England) and C. Juhlin (Uppsala U., Sweden) of Symposium G1, "Integrated studies of the continental lithosphere based on deep seismic profiling", at the biannual meeting of the European Union of Geosciences, 28 March - 1 April, 1999, Strasbourg, France.

**10. SERVICE TO THE UNIVERSITY**

*(a) Memberships on committees, including offices held and dates* [Information deleted]

**11. SERVICE TO THE COMMUNITY**

*(a) Memberships on scholarly societies, including offices held and dates*

Geological Association of Canada

Canadian Geophysical Union

Canadian Society of Exploration Geophysicists

American Geophysical Union

Geological Society of America

Society of Exploration Geophysicists

Fellow, Royal Society of Canada

*(b) Memberships on other societies, including offices held and dates*

*(c) Memberships on scholarly committees, including offices held and dates*

1971-74: Member, Subcommittee on Exploration Geophysics of Associate Committee on Geodesy and Geophysics of the National Research Council.

1976- 84: Member, COCRUST (Consortium for Crustal Reconnaissance present Using Seismic Techniques), now LITHOPROBE Seismology Group.

1981-87: Member, Transect B2 (Cordillera) Working Group for the North American Continent-Ocean Transect Program; and Member Working Group on the Pacific Margin; both of the Canadian Committee on the Dynamics and Evolution of the Lithosphere.

1985: Member, Logan Medal Selection Committee for the Geological Association of Canada.

1986-88: Member, Advisory Board for the U.S. Trans-Alaska Lithosphere Investigation (TALI) program.

1987-88: Member, NSF Review Panel on Lithospheric Seismology in the Continental Lithosphere Program.

1987-1989: Member, External Advisory Committee on Geophysics to the Geological Survey of Canada.

1990-1993: Member, Steering Committee for NATMAP, the national geoscience mapping project.

1991: Chairman, Selection Committee for the J. Tuzo Wilson Medal award of the Canadian Geophysical Union.

1994: Member, Advisory Committee and Invited Speaker, Lithospheric Science Workshop (sponsored by NSF and Air Force Office of Scientific Research), Taos, New Mexico.

1995-1997: Member, Committee on the Arthur L. Day Medal, Geological Society of America.

1995-1997: Member (Chair 1997), Committee on the George P. Woollard Award, Geological Society of America.

1995-2004 Member, Advisory Committee for Earth Systems Evolution Program, Canadian Institute for Advanced Research.

1997-2000 Member, Selection Committee for the Willet G. Miller Medal, Royal Society of Canada.

1998-2000: Member, NSERC Northern Task Force Committee

1999-2003 Member, Science and Advisory Board, Institute for Pacific Ocean Science & Technology

2001-2004 Member, Fellowship Selection Committee, Earth, Ocean and Atmospheric Sciences, Royal Society of Canada

2002-2004 Councilor, Geological Society of America

2002-2003 Chair, Committee on Penrose Medal Award, Geological Society of America

2003-2004 Chair, Committee on Day Medal Award, Geological Society of America

2003-2006 Member, NSERC Research Networks Selection Committee

2011-2015 Scientific Advisor, SinoProbe Deep Exploration of the Earth, Chinese Academy of Geological Sciences, China; the major Earth science project in China – Phase I

2015-2018 Member, Fellowship Selection Committee, Earth, Ocean and Atmospheric Sciences, Royal Society of Canada

2015- Member, Academic Advisory Board, SinoProbe Center-China Deep Exploration Center, Ministry of Land and Resources and China Geological Survey, China; continuation and expansion of SinoProbe as a new entity.

*(d) Memberships on other committees, including offices held and dates*

*(e) Editorships (list journal and dates)*

1984-2007 Associate Editor, Canadian Journal of Earth Sciences

2009-2010 Guest Editor, Lithoprobe special issues, Canadian Journal of Earth Sciences

*(f) Reviewer (journal, agency, etc. including dates)*

**12. AWARDS AND DISTINCTIONS**

*(a) Awards for Teaching (indicate name of award, awarding organizations, date)*

*(b) Awards for Scholarship (indicate name of award, awarding organizations, date)*

1966 Best Paper Award (Conference presentation), Canadian Society of Exploration Geophysicists

1968 Best Paper Award for papers published in *GEOPHYSICS*, Society of Exploration   
Geophysicists, U.S.A.

1969/70 National Research Council of Canada, Postdoctoral Fellowship

1981 Best Paper Award (Conference presentation), Canadian Society of Exploration Geophysicists

1987/88 U.B.C. Walter Isaak Killam Memorial Faculty Research Fellowship [declined to accept position of Director, Lithoprobe]

1987/88 Canada Council Killam Research Fellowship (renewable for a second year) [declined to accept position of Director, Lithoprobe]

1988 Past President's Medal (“for a recent outstanding accomplishment in earth science research”), Geological Association of Canada

1993 George P. Woollard Award (“for outstanding contributions to geology through the application of the principles and techniques of geophysics”; first Canadian recipient) Geological Society of America

1994 Fellow, Royal Society of Canada

1995 Honorary Member, Canadian Society of Exploration Geophysicists (highest society award for scientific contributions)

1995 Distinguished Fellow (“in recognition of substantial contributions to the geosciences”), Geological Association of Canada

1. Distinguished Lecturer Award, Canadian Institute of Mining, Metallurgy and Petroleum
2. UBC Killam Research Prize
3. J. Tuzo Wilson Medal for "outstanding contributions to Canadian geophysics", Canadian Geophysical Union

1998 Named a Member, Order of Canada (Canada's highest civilian honor)

2002 Queen's Golden Jubilee Medal ("for contributions to Canada")

2003 Visiting Fellowship, Japan Society for the Promotion of Science, Japan

2004-2006 Canada Council Killam Research Fellowship

2005 Logan Medal, Geological Association of Canada (highest society award; for "sustained distinguished achievement in Canadian earth science")

2008-2009 Canadian Society of Exploration Geophysicists 2009 Distinguished Lecturer

2012 Queen's Diamond Jubilee Medal ("for contributions to Canada")

*(c) Awards for Service (indicate name of award, awarding organizations, date)*

*(d) Other Awards*

**THE UNIVERSITY OF BRITISH COLUMBIA**

***Publications Record***

**SURNAME**: CLOWES **FIRST** **NAME**: Ronald **Initials**:

**MIDDLE NAME(S)**: Martin **Date**: August, 2015

**1. REFEREED PUBLICATIONS**

*(a) Journals*

1. **Clowes, R.M.,** E.R. Kanasewich, and G.L. Cumming. Deep crustal seismic reflections at near-vertical incidence, Geophysics, 33, 441-451 (1968).

2. Kanasewich, E.R., **R.M. Clowes,** and C.H. McCloughan. A buried Precambrian rift in western Canada, Tectonophysics, 8, 513-527 (1969).

3. **Clowes, R.M.** and E.R. Kanasewich. Seismic attenuation and the nature of reflecting horizons within the crust, J. Geophy. Res., 75, 6693-6705 (1970).

4. **Clowes, R.M.** and E.R. Kanasewich. Digital filtering of deep crustal seismic reflections, Can. J. Earth Sci., 9, 434-451 (1972).

5. Bertrand, A.E.S. and **R.M. Clowes**. Seismic array evidence for a two-layer core transition zone, Phys. Earth Planet. Int., 8, 251-268 (1974).

6. Bennett, G.T., **R.M. Clowes** and R.M. Ellis. A seismic refraction survey along the southern Rocky Mountain Trench, Canada, Bull. Seismol. Soc.Am., 65, 37-54 (1975).

7. **Clowes, R.M.** and S.J. Malecek. Preliminary interpretation of a marine deep seismic sounding survey in the region of Explorer Ridge, Can. J. Earth Sci., 13, 1545-1555 (1976).

8. Sketchley, D.J. and **R.M. Clowes**. A gravity survey of the igneous body at Little Mountain, Vancouver B.C., J. Can. Soc. Exploration Geophys., 12, 64-74 (1976).

9. Spence, G.D., R.M. Ellis and **R.M. Clowes**. Gravity evidence against a high-angle fault crossing the Rocky Mountain Trench near Radium, British Columbia, Can. J. Earth Sci., 14, 25-31 (1977).

10. Spence, G.D., **R.M. Clowes** and R.M. Ellis. Depth limits on the M-discontinuity in the southern Rocky Mountain Trench, Canada, Bull. Seismol. Soc. Am., 67, 543-546 (1977).

11. **Clowes, R.M**. A marine deep seismic sounding system, Can. J. Earth Sci., 14, 1276-1285 (1977).

12. Malecek, S.J. and **R.M. Clowes**. Crustal structure near Explorer Ridge from a marine deep seismic sounding survey, J. Geophys. Res., 83, 5899-5912 (1978).

13. Cumming, W.B., **R.M. Clowes** and R.M. Ellis. Crustal structure from a seismic refraction profile across southern British Columbia, Can. J. Earth Sci., 16 1024-1040 (1979).

14. **Clowes, R.M**. and S. Knize. Crustal structure from a marine seismic survey off the west coast of Canada, Can. J. Earth Sci., 16, 1265-1280 (1979).

15. Whittall, K.P. and **R.M. Clowes**. A simple, efficient method for the calculation of traveltimes and ray paths in laterally inhomogeneous media, J. Can. Soc. Exploration Geophys., 15, 21-29 (1979).

16. Levy, S. and **R.M. Clowes**. Debubbling: a generalized linear inverse approach, Geophys. Prosp., 28, 840-858 (1980).

17. **Clowes, R.M.,** A.J. Thorleifson and S. Lynch. Winona basin, West Coast Canada: crustal structure from marine seismic studies, J. Geophys. Res., 86, 225-242 (1981).

18. Cheung, H.P.Y. and **R.M. Clowes**. Crustal structure from P and S wave analyses: ocean bottom seismometer results in the northeast Pacific, Geophys. J.R. astr. Soc., 65, 47-73 (1981).

19. Au, D. and **R.M. Clowes**. Crustal structure from an OBS survey of the Nootka fault zone off western Canada. Geophys. J.R. astr. Soc., 68, 27-47 (1982).

20. **Clowes, R.M**. and D. Au. In-situ evidence for a low degree of S-wave anisotropy in the oceanic upper mantle. Geophys. Res. Lett., 9, 13-16 (1982).

21. Ellis, R.M., G.D. Spence, **R.M. Clowes**, D.A. Waldron, I.F. Jones, A.G. Green, D.A. Forsyth, J.A. Mair, M.J. Berry, R.F. Mereu, E.R. Kanasewich, G.L. Cumming, Z. Hajnal, R.D. Hyndman, G.A. McMechan and B.D. Loncarevic. The Vancouver Island Seismic Project: A COCRUST onshore-offshore study at a convergent margin. Can. J. Earth Sci., 20, 719-741 (1983).

22. **Clowes, R.M**., R.M. Ellis, Z. Hajnal and I.F. Jones. Seismic reflections from the subducting lithosphere? Nature, 303, 668-670 (1983).

23. Green, A.G. and **R.M. Clowes**. Deep geology from seismic reflection studies in Canada. First Break, 1, No. 7 (July), 24-33 (1983).

24. Au, D., and **R.M. Clowes**. Shear wave velocity structure of the oceanic lithosphere from ocean bottom seismometer studies. Geophys. J.R. astr Soc., 77, 105-123 (1984).

25. Spence, G.D., K.P. Whittall and **R.M. Clowes.** Practical synthetic seismograms for laterally varying media calculated by asymptotic ray theory. Bull. Seism. Soc. Amer., 74, 1209-1223 (1984).

26. **Clowes, R.M.** Phase 1 Lithoprobe - A Coordinated National Geoscience Project. Geoscience Canada, 11, (No. 3), 122-126 (1984).

27. Horn, J.R., **R.M. Clowes**, R.M. Ellis and D.N. Bird. The seismic structure across an active oceanic/continental transform fault zone. J. Geophys. Res., 89, 3107-3120 (1984).

28. White, D.J. and **R.M. Clowes**. Seismic investigation of the Coast Plutonic Complex-Insular Belt Boundary beneath Georgia Strait. Can. J. Earth Sci., 21, 1033-1049 (1984).

29. **Clowes, R.M**., A.G. Green, C.J. Yorath, E.R. Kanasewich, G.F. West and G.D. Garland. LITHOPROBE, a national program for studying the third dimension of geology. J. Can. Soc. Expl. Geophys., 20, 23-39 (1984).

30. Monger, J.W.H., **R.M. Clowes**, R.A. Price, R.P. Riddihough, P. Simony and G.J. Woodsworth. Continent-ocean transect B2: Juan de Fuca plate to Alberta plains. Geol. Soc. Amer., Decade of North American Geology, Continent: Ocean Transect 7, 2 sheets, 21 pp. text (1985).

31. Spence, G.D., **R.M. Clowes** and R.M. Ellis. Seismic structure across the active subduction zone of western Canada. J. Geophys. Res., 90, 6754-6772 (1985).

32. **Clowes, R.M**. and E. Gens-Lenartowicz. Upper crustal structure of southern Queen Charlotte Basin from sonobuoy refraction studies. Can. J. Earth Sci., 11, 1696-1710 (1985).

33. Yorath, C.J., A.G. Green, **R.M. Clowes**, A. Sutherland Brown, M.T. Brandon, E.R. Kanasewich and R.D. Hyndman. LITHOPROBE-Southern Vancouver Island: Seismic reflection sees through Wrangellia to the Juan de Fuca plate. Geology, 13, 759-762 (1985).

34. Green, A.G., **R.M. Clowes**, C.J. Yorath, C. Spencer, E.R. Kanasewich, M.T. Brandon, and A. Sutherland Brown. Seismic reflection imaging of the subducting Juan de Fuca plate. Nature, 319, 210-213 (1986).

35. Davis, E.E. and **R.M. Clowes**. High velocities and seismic anisotropy in Pleistocene turbidites off western Canada. Geophys. J.R. astr. Soc., 84, 381-400 (1986).

36. Mereu, R.F., D. Wang, O. Kuhn, D.A. Forsyth, A.G. Green, P. Morel, G.G.R. Buchbinder, D. Crossley, E. Schwarz, R. duBerger, C. Brooks, and **R.M. Clowes**. The 1982 COCRUST seismic experiment across the Ottawa-Bonnechine graben and Grenville Front in Ontario and Quebec. Geophys. J.R. astr Soc., 84, 491-514 (1986).

37. **Clowes, R.M.,** M.T. Brandon, A.G. Green, C.J. Yorath, A. Sutherland Brown, E.R. Kanasewich, and C. Spencer. LITHOPROBE-Southern Vancouver Island: Cenozoic subduction complex imaged by deep seismic reflections. Can. J. Earth Sci., 24, 31-51 (1987).

38. Green, A.G., B. Milkereit, L. Mayrand, C. Spencer, R. Kurtz and **R.M. Clowes**. LITHOPROBE seismic reflection profiling across Vancouver Island. Geophys. J. R. astr. Soc., 89, 85-90 (1987).

39. **Clowes, R.M**., C.J. Yorath and R.D. Hyndman. Reflection mapping across the convergent margin of western Canada. Geophys. J.R. astr. Soc., 89, 79-84 (1987).

40. **Clowes, R.M.,** E. Gens-Lenartowicz, M. Demartin and S. Saxov. Lithospheric structure in southern Sweden - Results from FENNOLORA. Tectonophysics, 142, 1-14 (1987).

41. Kanasewich, E.R., Z. Hajnal, A.G. Green, G.L. Cumming, R.F. Mereu, **R.M. Clowes**, P. Morel-à-l'Huissier, S. Chiu, C.G. Macrides, M. Shahriar and A.M. Congram. Seismic studies of the crust under the Williston Basin. Can. J. Earth Sci., 24, 2160-2171 (1987).

42. Monger, J.W.H., **R.M. Clowes**, D.S. Cowan, C.J. Potter, R.A. Price and C.J. Yorath. Continent-ocean transitions in western North America between latitudes 46 and 56 degrees: *In* Phanerozoic Evolution of North American Continent-Ocean Transitions, R.C. Speed (ed.), Boulder, CO, Geol. Soc. Amer., DNAG Continent-Ocean Transect Volume, 357-397 (1994).

43. **Clowes, R.M**., M.T. Brandon, A.G. Green, C.J. Yorath, A. Sutherland Brown, E.R. Kanasewich and C.P. Spencer. LITHOPROBE - southern Vancouver Island: Cenozoic subduction complex imaged by deep seismic reflections: Reply. Can. J. Earth Sci., 25, 164-165 (1988).

44. Dehler, S.A. and **R.M. Clowes.** The Queen Charlotte Islands refraction project: Part I - The Queen Charlotte Fault Zone.  Can. J. Earth Sci., 25, 1857-1870 (1988).

45. Mackie, D.J., **R.M. Clowes**, S.A. Dehler, R.M. Ellis and P. Morel-à-Huissier. The Queen Charlotte Islands refraction project: Part II - Structural model for transition from Pacific plate to North American plate. Can. J. Earth Sci., 26, 1713-1725 (1989).

46. Green, A., B. Milkereit, J. Percival, A. Davidson, R. Parrish, F. Cook, W. Geis, W. Cannon, D. Hutchinson, G. West and **R. Clowes**. Origin of deep crustal reflections: Seismic profiling across high grade metamorphic terranes in Canada. Tectonophysics, 173, 627-638 (1990).

47. Hyndman, R.D., C.J. Yorath, **R.M. Clowes** and E.E. Davis. The northern Cascadia subduction zone at Vancouver Island: Seismic structure and tectonic history. Can. J. Earth Sci., 27, 313-329 (1990).

48. White, D.J. and **R.M. Clowes**. Shallow crustal structure beneath the Juan de Fuca Ridge from 2-D seismic refraction tomography. Geophys. J. Int., 100, 349-367 (1990).

49. Calvert, A.J., E.O. Hasselgren and **R.M. Clowes**. Oceanic rift propagation - a cause of crustal underplating and seamount volcanism. Geology, 18, 886-889 (1990).

50. Calvert, A.J. and **R.M. Clowes**. Deep, high-amplitude reflections from a major shear zone above the subducting Juan de Fuca plate. Geology, 18, 1091-1094 (1990).

51. Calvert, A.J. and **R.M. Clowes**. Seismic evidence for the migration of fluids within the accretionary complex of western Canada. Can. J. Earth Sci., 28, 542-556 (1991).

51A. Cook, F.A., J.L. Varsek and R.M. Clowes. LITHOPROBE reflection transect of southwestern Canada: Mesozoic thrust and fold belt to mid-ocean ridge. *In* Continental Lithosphere: Deep Seismic Reflections. Edited by R. Meissner, L. Brown, H.-J. Dürbaum et al. American Geophysical Union Geodynamics Series, 22, 247-255.

52. Cook, F., J. Varsek, **R.M. Clowes**, E. Kanasewich, C. Spencer, R. Parrish, R. Brown, S. Carr, B. Johnson and R. Price. LITHOPROBE crustal reflection cross section of the southern Canadian Cordillera I: Foreland thrust and fold belt to Fraser River fault. Tectonics, 11, 12-35 (1992).

53. Hasselgren, E., **R.M. Clowes** and A.J. Calvert. Propagating rift pseudofaults -- zones of crustal underplating imaged by multichannel seismic reflection data. Geophys. Res. Lett., 19, 485-488 (1992).

54. Hole, J.A., **R.M. Clowes** and R.M. Ellis. Interface inversion using broadside seismic refraction data and three-dimensional travel time calculations. J. Geophys. Res., 97, 3417-3429 (1992).

55. Dehler, S.A. and **R.M. Clowes**. Integrated geophysical modelling of terranes and other structural features along the western Canadian margin. Can. J. Earth Sci., 29, 1492-1508 (1992).

56. Zelt, B.C., R.M. Ellis, **R.M. Clowes** and 7 others. Crust and upper mantle structure of the Intermontane belt southern Canadian Cordillera. Can. J. Earth Sci., 29, 1530-1548 (1992).

57. **Clowes, R.M**. and 7 others. LITHOPROBE -- New perspectives on crustal evolution. Can. J. Earth Sci., 29, 1813-1864 (1992).

58. Varsek, J.L., F.A. Cook, **R.M. Clowes** and 5 others. LITHOPROBE crustal reflection structure of the southern Canadian Cordillera II: Coast Mountains transect. Tectonics, 12, 334-360 (1993).

59. **Clowes, R.M**. Variations in continental crustal structure in Canada from LITHOPROBE seismic reflection and other data. Tectonophysics, 219, 1-27 (1993).

60. Lucas, S.B., A. Green, Z. Hajnal, D. White, J. Lewry, K. Ashton, W. Weber and **R. Clowes**. Deep seismic profile across a Proterozoic collision zone: surprises at depth. Nature*,* 363, 339-342 (1993).

61. Cudrak, C.F. and **R.M. Clowes**. Crustal structure of Endeavor Ridge segment, Juan de Fuca Ridge, from a seismic refraction survey. J. Geophys. Res.*,* 98, 6329-6349 (1993).

62. Zelt, B.C., R.M. Ellis and **R.M. Clowes**. Crustal velocity structure in the eastern Insular and southernmost Coast belts, Canadian Cordillera. Can. J. Earth Sci., 30, 1014-1027 (1993).

63. Fuis, G.S. and **R.M. Clowes**. Comparison of deep structure along three transects of the western North American continental margin. Tectonics, 12, 1420-1435 (1993).

64. Hole, J.A., **R.M. Clowes** and R.M. Ellis. Interpretation of three-dimensional seismic refraction data from western Hecate Strait, British Columbia: Structure of the Queen Charlotte Basin. Can. J. Earth Sci., 30, 1427-1439 (1993).

65. Hole, J.A., **R.M. Clowes** and R.M. Ellis. Interpretation of three-dimensional seismic refraction data from western Hecate Strait, British Columbia: Structure of the crust. Can. J. Earth Sci., 30, 1440-1452 (1993).

66. O'Leary, D.M., **R.M. Clowes** and R.M. Ellis. Crustal velocity structure in the southern Coast Belt, British Columbia. Can. J. Earth Sci., 30, 2389-2403 (1993).

67. White, D.J. and **R.M. Clowes**. Seismic attenuation structure beneath the Juan de Fuca Ridge from tomographic inversion of amplitudes. J. Geophys. Res., 99, 3043-3056 (1994).

68. **Clowes, R.M.** LITHOPROBE - geoscience probing of inner space leads to new developments for mining exploration. CIM Bulletin, 87, 36-48 (1994).

69. Marillier, F., B. Roberts, J. Hall, K. Louden, I. Reid, S. Hughes, H. Lu, T. Coté, **R.M. Clowes** and 6 others. Lithoprobe East onshore-offshore seismic refraction survey - constraints on interpretation of reflection data in the Newfoundland Appalachians. Tectonophysics, 232, 43-58 (1994).

70. Lucas, S.B., D. White, Z. Hajnal, J. Lewry, A. Green, **R.M. Clowes** and 7 others. Three dimensional collisional structure of the Trans-Hudson Orogen, Canada. Tectonophysics, 232, 161-178 (1994).

71. Lewry, J.F., Z. Hajnal, A. Green, S. Lucas, D. White, M. Stauffer, K. Ashton, W. Weber and **R.M. Clowes**. Structure of a Paleoproterozoic continent - continent collision zone: a LITHOPROBE seismic reflection profile across the Trans-Hudson Orogen, Canada. Tectonophysics, 232, 143-160 (1994).

72. Kanasewich, E.R., M.J.A. Burianyk, R.M. Ellis, **R.M. Clowes** and 5 others. Crustal velocity structure of the Omineca Belt, southeastern Canadian Cordillera. J. Geophys. Res., 99, 2653-2670 (1994).

73. Hasselgren, E.O. and **R.M. Clowes**. Crustal structure of northern Juan de Fuca plate from multichannel reflection data. J. Geophys. Res., 100, 6469-6486 (1995).

74. **Clowes, R.M**., C.A. Zelt, J.R. Amor and R.M. Ellis. Lithospheric structure in the southern Canadian Cordillera from a network of seismic refraction lines. Can. J. of Earth Sci., 32, 1485-1513 (1995).

75. Zelt, B.C., R.M. Ellis, **R.M. Clowes** and J.A. Hole. Inversion of three-dimensional wide-angle seismic data from the southwestern Canadian Cordillera. J. Geophys. Res., 101, 8503-8529 (1996).

76. **Clowes, R.M**., A.J. Calvert, D.W. Eaton, Z. Hajnal, J. Hall and G.M. Ross. Lithoprobe reflection studies of Archean and Proterozoic crust in Canada. Tectonophysics, 264, 65-88 (1996).

1. Hammer, P.T.C. and **R.M. Clowes**. Moho reflectivity patterns - a comparison of Canadian Lithoprobe transects. Tectonophysics, 269, 179-198 (1997).

78. Hammer, P.T.C. and **R.M. Clowes**. Seismic reflection investigations of the Mount Cayley bright spot: A midcrustal reflector beneath the Coast Mountains, British Columbia. J. Geophys. Res., 101, 20119-20131 (1996).

79. **Clowes, R.M**. Lithoprobe Phase IV: Multidisciplinary studies of the evolution of a continent - a progress report. Geoscience Canada, 23, 109-123 (1996).

80. **Clowes, R.M**., D.J. Baird and S.A. Dehler. Crustal structure of the Cascadia subduction zone, southwestern British Columbia, from potential field and seismic studies. Can. J. Earth Sci., 34, 317-335 (1997).

81. Mandler, H.A.F. and **R.M. Clowes**. Evidence for extensive tabular intrusions in the Precambrian shield of western Canada: A 160 km long sequence of bright reflections. Geology, 25, 271-274 (1997).

82. Hajnal, Z., B. Nemeth, **R.M. Clowes**, R.M. Ellis, and 5 others. Mantle involvement in lithospheric collision: Seismic evidence from the Trans-Hudson Orogen, western Canada. Geophys. Res. Lett., 24, 2079-2082 (1997).

83. Ross, G.M., D.W. Eaton, D.E. Boerner and **R.M. Clowes**. Geologists probe buried craton in Western Canada. EOS, Transactions AGU, 78, 493-494 and 497 (1997).

1. Mandler, H.A.F. and **R.M. Clowes**. The HSI bright reflector: further evidence for extensive magmatism in the Precambrian of western Canada. Tectonophysics, 288, 71-81 (1998).
2. Deep Probe Working Group (T. Henstock, A. Levander, R. Keller, C. Snelson, K. Miller, S. Harder, A. Gorman, **R. Clowes** and M. Burianyk). Probing the depths of western North America: Contrasting Archean and Proterozoic lithosphere with controlled source seismology. GSA Today, 8 (no. 7, July), 1-5, 16, 17 (1998).
3. **Clowes, R.M.,** F.A. Cook and J.N. Ludden. Lithoprobe leads to new perspectives on crustal evolution. GSA Today, 8 (no. 10, October), 1-7 (1998).
4. Gorman, A.R. and **R.M. Clowes**. Wave-field tau-*p* analysis for 2-D velocity models: Application to western North American lithosphere. Geophys. Res. Lett. 26, 2323-2326 (1999).
5. **Clowes, R.M**., F. Cook, Z. Hajnal, J. Hall, J. Lewry, S. Lucas, and R. Wardle. Canada's Lithoprobe Project (collaborative, multidisciplinary geoscience research leads to new understanding of continental evolution). Episodes, 22, 3-20 (1999).
6. Fernandez Viejo, G., **R.M. Clowes,** and J.R. Amor. Seismic wide-angle reflections from the lithospheric mantle in northwestern Canada. Geophys. Res. Lett., 26, 2809-2812 (1999).
7. Eaton, D.W., G.M. Ross, and **R.M. Clowes.** Seismic-reflection and potential-field studies of the Vulcan structure, western Canada: A Paleoproterozoic Pyrenees? J. Geophys. Res., 104, 23255-23269 (1999).
8. Hammer, P.T.C., **R.M. Clowes**, and R.M. Ellis. Crustal structure of NW British Columbia and SE Alaska from seismic wide-angle studies: Coast Plutonic Complex to Stikinia. J. Geophys. Res.,105, 7961-7981 (2000).
9. Roy, B. and **R.M. Clowes**. Seismic and potential-field imaging of the Guichon Creek batholith, British Columbia, Canada to delineate structures hosting porphyry copper deposits. Geophysics, 65, 1418-1434 (2000).
10. **Clowes, R.M**. Deep structure and seismic-reflection studies in Precambrian mining regions: Examples from the Canadian Lithoprobe project. Mining Engineering*,* March 2001, 54-60 (2001)*.*
11. Welford, J.K., **R.M. Clowes**, R.M. Ellis, G.D. Spence, I. Asudeh and Z. Hajnal. Lithospheric structure across the craton-Cordilleran transition of northeastern British Columbia. Can. J. Earth Sci., 38, 1169-1189 (2001).
12. Gorman, A.R., **R.M. Clowes**, R.M. Ellis and 9 others. Deep Probe - Imaging the roots of western North America. Can. J. Earth Sci., 39, 375-398 (2002).
13. **Clowes, R.M**., M.J. Burianyk, A.R. Gorman and E.R. Kanasewich. Crustal velocity structure from SAREX, the southern Alberta refraction experiment. Can. J. Earth Sci., 39, 351-373 (2002).
14. Snyder, D.B., **R.M. Clowes**, F.A. Cook, P. Erdmer, C. Evenchick, A.J. van der Velden and K.W. Hall. Proterozoic prism arrests suspect terranes: Insights into the ancient Cordilleran margin from seismic reflection data. GSA Today, 12 (no. 10, October), 4-10 (2002).

98. Fernández Viejo, G. and **R.M. Clowes**. Lithospheric structure beneath the Archean Slave Province and Proterozoic Wopmay Orogen, northwest Canada, from a Lithoprobe refraction/wide-angle reflection survey. Geophys. J. Int., 153, 1-19 (2003).

99. Cook, F.A., **R.M. Clowes**, D.B. Snyder, A.J. van der Velden, K.W. Hall, P. Erdmer and C.A. Evenchick. Precambrian crust beneath the Mesozoic Northern Canadian Cordillera discovered by Lithoprobe seismic reflection profiling. Tectonics, 23 (no. 2), doi: TC2010 *1029/2002TC001412* [28 p] (2003).

100. Hammer, P.T.C., **R.M. Clowes** and K. Ramachandran. High-resolution seismic reflection imaging of a thin, diamondiferous, kimberlite dike. Geophysics, 69, 1143-1154 (2004).

101. Hammer, P.T.C. and **R.M. Clowes**. The accreted terranes of northwestern British Columbia, Canada: Lithospheric velocity structure and tectonics. J. Geophys. Res., 109, B06305, doi:1029/2003JB002749. [19p] (2004).

102. Hammer, P.T.C., **R.M. Clowes** and K. Ramachandran. Seismic reflection imaging of thin, kimberlite dykes and sills: Exploration and deposit characterization of the Snap Lake dyke, Canada. Lithos, 76, 359-367 (2004).

103. Welford, J.K. and **R.M. Clowes**. Deep 3-D seismic reflection imaging of Precambrian sills in southwestern Alberta, Canada. Tectonophysics, 388, 161-172 (2004).

104. **Clowes, R.M.**, P.T.C. Hammer, G. Fernandez Viejo and J.K. Welford. Lithospheric structure in northwestern Canada from Lithoprobe seismic refraction and related studies: A synthesis. Can. J. Earth Sci., 42, 1277-1293 (2005).

105. Fernandez Viejo, G., **R.M. Clowes** andJ.K. Welford. Constraints on the composition of the crust and uppermost mantle in northwestern Canada: Vp/Vs variations along Lithoprobe’s SNorCLE Transect. Can. J. Earth Sci., 42, 1205-1222 (2005).

106. Nemeth, B., **R.M. Clowes** and Z. Hajnal. Lithospheric structure of the Trans-Hudson Orogen from seismic refraction/wide-angle reflection studies. Can. J. Earth Sci., 42, 435-456 (2005).

107. Hajnal, Z., J. Lewry, D. White, K. Ashton, **R.M. Clowes**, M. Stauffer, I. Gyorfi and E. Takacs. The Sask Craton and Hearne Province margin: Seismic reflection studies in the western Trans-Hudson Orogen. Can. J. Earth Sci., 42, 403-419 (2005).

108. McClymont, A.F. and **R.M. Clowes**. Anomalous lithospheric structure of northern Juan de Fuca plate – a consequence of oceanic rift propagation? Tectonophysics, 406, 213-231 (2005).

109. Gorman, A.R., B. Németh, **R.M. Clowes** and Z. Hajnal. An investigation of upper mantle heterogeneity beneath the Archean and Proterozoic crust of western Canada from Lithoprobe controlled-source seismic experiments. Tectonophysics, 416, 187-207 (2006).

110. Welford, J.K. and **R.M. Clowes**. Three-dimensional seismic reflection investigation of the upper crustal Winagami sill complex of northwestern Alberta, Canada. Geophys. J. Int., 166, 155-169 (2006).

111. Hammer, P.T.C. and **R.M. Clowes**. Lithospheric-scale structures across the Alaskan and Canadian Cordillera: Comparisons and tectonic implications. *In* Whence the Mountains? Inquiries into the Evolution of Orogenic Systems: A Volume in Honor of Raymond A. Price, *edited by* J. Sears, T. Harms and C. Evenchick, Geological Society of America, *Special Paper 433, 99-116* (2007)*.*

112 Welford, J.K., E.H. Hearn and **R.M. Clowes**. The possible role of mid-crustal igneous sheet intrusions in cratonic arch formation. Tectonics, 26, TC5012, doi:10.1029/2006TC002023, 11 p. (2007).

113. Snyder, D.B., M. Pilkington, **R.M. Clowes** and F.A. Cook. The underestimated Proterozoic component of the Canadian Cordillera accretionary margin. *In* Earth Accretionary Systems in Space and Time, *edited by* P.A. Cawood and A. Kröner, The Geological Society, London, *Special Publications, 318, 257-271* (2009).

114. Oueity, J. and **R.M. Clowes**. Paleoproterozoic subduction in NW Canada from near-vertical and wide-angle seismic reflection data. Can. J. Earth Sci., 47, 35-52 (2010).

115. **Clowes, Ron M**. Initiation, development and benefits of Lithoprobe – Shaping the direction of Earth science research in Canada and beyond. Can. J. Earth Sci., 47, 291-314 (2010).

116. **Clowes, R.M.**, D.J. White and Z. Hajnal. Mantle heterogeneities and their significance: Results from Lithoprobe seismic reflection and refraction/wide-angle reflection studies. Can. J. Earth Sci., 47, 409-443 (2010).

117. Cook, F.A., D.J. White, A.G. Jones, D.W. S. Eaton, J. Hall and **R.M. Clowes**. How the crust meets the mantle: Lithoprobe perspectives on the Mohorovičić discontinuity and crust-mantle transition. Can. J. Earth Sci., 47, 315-351 (2010).

118. Hammer, Philip T.C., **Ron M. Clowes**, Fred A. Cook, Arie J. van der Velden and Kris Vasudevan. The Lithoprobe trans-continental lithospheric cross sections: imaging the internal structure of the North American continent. Can. J. Earth Sci., 47, 821-857 (2010).

119. Oueity, Jounada and **Ron M. Clowes**.  Nature of the Moho in NW Canada from combined near-vertical and wide-angle seismic-reflection studies. Lithosphere, 2, 377-396 (2010).

120. Kumar, Vishal, Jounada Oueity, **Ron Clowes** and Felix Herrmann. Enhancing crustal reflection data through curvelet denoising. Tectonophysics, 508, 106-116 (2011).

121. Stephenson, A.L., G.D. Spence, K. Wang, J.A. Hole, K.C. Miller, **R.M. Clowes**, S.H. Harder and G.M. Kaip. Crustal velocity structure of the southern Nechako basin, British Columbia, from wide-angle seismic traveltime inversion. Can. J. Earth Sci., 48, 1050-1063 (2011).

122. Smithyman, Brendan and **Ron M. Clowes**. Waveform tomography of field vibroseis data using an approximate 2D geometry leads to improved velocity models. Geophysics, 77 (no. 1), R33-R43 (2012).

123. Percival, John A., Fred A. Cook and **Ron M. Clowes** (Editors). Tectonic Styles in Canada: the Lithoprobe Perspective. Geological Association of Canada, Special Paper 49, 498 p. (2012).

124. Cook, F.A., J.A. Percival and **R.M. Clowes**. Tectonic styles in Canada: Lithoprobe perspectives on the evolution of the North American continent. *In* Percival, John A., Fred A. Cook and Ron M. Clowes (Editors). Tectonic Styles in Canada: the Lithoprobe Perspective. Geological Association of Canada, Special Paper 49, p. 467-498 (2012).

125. Smithyman, Brendan and **Ron M. Clowes**. Waveform tomography in 2.5D: Parameterization for crooked-line acquisition geometry. J. Geophys. Res. Solid Earth, 118, 2119-2137 (2013), doi: 10.1002/jgrb.50100, 2013.

126. Bustin, A.M.M., **R.M. Clowes**, J.W.H. Monger and J. M. Journeay. The southern Coast Mountains, British Columbia: New interpretations from geological, seismic reflection and gravity data. Can. J. Earth Sci.,50, 1033-1050 (2013).

127. Smithyman, B.R., R.M. Clowes and E. Bordet. New geophysical models for subsurface velocity structure in the Nechako–Chilcotin plateau from 2.5-D waveform tomography. Can. J. Earth Sci., 51, 373-392 (2014).

128. **Clowes, R.M.** Geophysics and geology: An essential combination as illustrated by LITHOPROBE interpretations – Part 1, Lithospheric examples. Geoscience Canada [Logan Medallist Series], 42, 27-60 (2015).

129. **Clowes, R.M.** Geophysics and geology: An essential combination as illustrated by LITHOPROBE interpretations – Part 2, Exploration examples. Geoscience Canada [Logan Medallist Series], 44, 135-180 (2017).

130. **Clowes, R.M.** and B. Roy. Crustal structure of the metasedimentary Kisseynew domain and bounding volcanic-plutonic domains, Trans-Hudson orogen, Canada. Can. J. Earth Sci., 58 (no. 3), 269-285 (2021).

*(b) Conference Proceedings*

FULL LENGTH REFEREED PAPERS

1. Kanasewich, E.R. and **R.M. Clowes**. Geophysical studies of the earth's crust and upper mantle in western Canada, XXIII International Geological Congress, Prague, 1, 239-247 (1968).

2. **Clowes, R.M**., G.D. Spence, R.M. Ellis and D.A. Waldron. Structure of the lithosphere in a young subduction zone: results from reflection and refraction studies. *In* Reflection Seismology: The Continental Crust: AGU Geodynamics Series, 14, 313-321 (1986).

3. Green, A.G., M.J. Berry, C.P. Spencer, E.R. Kanasewich, S. Chiu, **R.M. Clowes**, C.J. Yorath, D.B. Stewart, J.D. Unger and W.H. Poole, Recent seismic reflection studies in Canada. *In* Reflection Seismology: A Global Perspective, AGU Geodynamics Series, 13, 85-97 (1986).

4. Drew, J.J. and **R.M. Clowes**. A re-interpretation of the seismic structure across the active subduction zone of western Canada. *In* Studies in Laterally Heterogeneous Structures using Seismic Refraction and Reflection Data, A.G. Green (ed.), Geol. Surv. Can. Paper 89-13, 115-132 (1990).

5. Green, A.G., **R.M. Clowes** and R.M. Ellis. Crustal studies across Vancouver Island and adjacent offshore margin. *In* Studies in Laterally Heterogeneous Structures using Seismic Refraction and Reflection Data, A.G. Green (ed.), Geol. Surv. Can. Paper 89-13, 3-25 (1990).

6. Waldron, D.A., **R.M. Clowes** and D.J. White. Seismic structure of a subducting oceanic plate off western Canada. *In* Studies in Laterally Heterogeneous Structures using Seismic Refraction and Reflection Data, A.G. Green (ed.), Geol. Surv. Can. Paper 89-13, 105-113 (1990).

7. **Clowes, R.M**.. LITHOPROBE - Multidisciplinary studies of continental evolution: an example from western Canada. *In* Proceedings Pacific Rim Congress 90, Gold Coast Queensland Australia 6-12 May 1990, Australian Institute of Mining and Metallurgy, Parkville, Victoria, Australia, III, 83-97 (1990).

8. Cook, F.A., J.L. Varsek and **R.M. Clowes.** LITHOPROBE reflection transect of southwestern Canada: Mesozoic thrust and fold belt to mid-ocean ridge. *In* Continental Lithosphere: Deep Seismic Reflections, R. Meissner et al. (editors), AGU Geodynamics Series, 22, 247-255 (1991).

9. **Clowes, R.M.** and R.D. Hyndman. Geophysical studies of the northern Cascadia subduction zone off western Canada and their implications for great earthquake seismotectonics: A review. *In* Seismotectonics in Convergent Plate Bounday, Y. Fujinawa and A. Yoshida (editors), TERRAPUB, Tokyo, 1-23 (2002).

EDITED REFEREED VOLUMES

1. **Clowes, R.M**. and A.G. Green (Editors) 1994. Special Issue on “Seismic Reflection Probing of the Continents and Their Margins.” Tectonophysics, 232, 1-450.

2. **Clowes, R.M.** (Editor) 2010. Lithoprobe – Parameters, processes and the evolution of a continent. Two special issues (22 papers) of Canadian Journal of Earth Sciences, 47, 291-857.

*(c) Other*

**2. NON-REFEREED PUBLICATIONS**

*(a) Journals*

1. **Clowes, R.M.** Phase 1 Lithoprobe - A Coordinated National Geoscience Project. Geoscience Canada, 11, 122-126 (1984).

2. Ellis, R.M. and **R.M. Clowes**. Earthquake risk is investigated. Offshore Resources, 2, No. 3, 12-13 (1984).

3. **Clowes, R.M.** LITHOPROBE - Vancouver Island, Canada: Exploring a subduction zone. The Leading Edge, 6, no. 6, 12-19 (1987). (This is a major review paper for the Society of Exploration Geophysicists, Tulsa, OK.)

4. **Clowes, R.M.** LITHOPROBE - An integrated approach to studies of crustal evolution. Geotimes, 12-14 (August 1992).

5. **Clowes, Ron M.**, 2009 A new view of the continent beneath our feet – Lithoprobe’s scientific, economic and social contributions. CSEG Recorder, 34 (no. 3, March), 7-16.

*(b) Conference Proceedings*

1. **Clowes, R.M**., E. Gens-Lenartowicz and S. Saxov. Fennolora - A preliminary interpretation between shot points W and C. *In* Proceedings of the First Workshop on the European Geotraverse, G.A. Galson and St. Mueller (eds.), European Science Foundation, 151-165 (1984).
2. **Clowes, R.M**., Crustal structure of northern Juan de Fuca plate and Cascadia subduction zone - new results, old data. *In* S.H. Kirby, K. Wang and S. Dunlop (editors), The Cascadia subduction zone and related subduction systems - seismic structure, intraslab earthquakes and processes, and earthquake hazards, United States Geological Survey Open File Report 02-328 and Geological Survey of Canada Open File 4350, 55-58 (2002).

**3. BOOKS**

*(a) Authored*

1. Wilson, John and **Ron Clowes**. Ghost Mountains and Vanished Oceans: North America from Birth to Middle Age, a book about Lithoprobe results prepared for the general public. Key Porter Books, Toronto, Canada, 248 pp (2009).

*(b) Edited*

1. **Clowes, R.M**. (editor). LITHOPROBE Phase III Proposal - The Evolution of a Continent. Published by the LITHOPROBE Secretariat, University of British Columbia, Vancouver, B.C., 213 pp. (1989).

1. **Clowes, R.M.** (editor). LITHOPROBE Phase IV Proposal - Studies of the Evolution of a Continent. Published by the LITHOPROBE Secretariat, University of British Columbia, Vancouver, B.C., 290 pp. (1993).
2. **Clowes, R.M.** (editor). Lithoprobe Phase V Proposal Evolution of a Continent Revealed. Published by the LITHOPROBE Secretariat, University of British Columbia, Vancouver, B.C., 292 pp. (1997).

[I have included these proposals because post-production, they have been assigned ISBN numbers. The books have been sent to libraries at colleges and universities across Canada at the request of some educators because of their scientific content.]

1. Percival, John A., Fred A. Cook and **Ron M. Clowes** (Editors). Tectonic Styles in Canada: the Lithoprobe Perspective. Geological Association of Canada, Special Paper 49, 498 p. (2012).

*(c) Chapters*

**4. PATENTS**