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WORKSHOP REPORT

The State of Earth Science Outreach in Canada and an Action Plan for the Future: Results of a Session and Workshop Held in Yellowknife, N.W.T., May 24-27, 2007

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This report outlines the nature and content of a major session on geoscience outreach held at the annual meeting of the Geological Association of Canada and the Mineralogical Association of Canada (GAC⁷-MAC) in Yellowknife in May 2007 and the output of a workshop aimed at developing a clear framework for the planning of geoscience outreach activities in Canada, which took place on the weekend following the sessions.

THE SESSIONS

The largest session in the technical program at the Annual Meeting of the Geological Association of Canada and the Mineralogical Association of Canada in Yellowknife in May 2007 was a session on earth science outreach entitled: *Geoscience Skills for Canadian Communities*. A total of twenty-six presentations were made at this session that started in the afternoon of Thursday

24 May 2007 and ran through to the end of the conference on Friday 25 May 2007.

The early talks in the session dealt partly with national programs like the Canadian Geoscience Education Network (Fran Haidl, Saskatchewan Industry and Resources), the new book on the geology of Canada to be published in honour of the International Year of Planet Earth entitled *Four Billion Years and Counting: Canada's Geological Heritage* (Godfrey Nowlan et al., Geological Survey of Canada), and the EdGEO program of workshops for teachers (Eileen van der Flier Keller, University of Victoria). Al Donaldson (Carleton University) provided convincing evidence of the importance of interpreting earth sciences for those on cruises, citing many examples of the value of this kind of outreach. Jan Aylsworth (GSC) outlined NRCan's new program of outreach associated with the Hazards Program and Walt Humphries of Yellowknife provided an overview of the NWT Mining Heritage Society that is actively preserving aspects of the mining heritage in the Yellowknife area. The group who stayed on for the workshop (see Appendix) got a chance to see some of this work first hand.

Two talks dealt specifically with the importance of education in mining: Laura Clinton outlined the great success of the Mining Matters program in Ontario aimed at school-age children and Kate Bruce highlighted the Mine Training Program offered to both secondary and post-secondary students in Yellowknife. It is a joint program of the Kimberlite Career and Technical Centre and Aurora College.

Another two talks were delivered on industrial minerals and the importance of information about them.

Dixon Edwards, who received the 2007 Geological Association of Canada E.R.W. Neale Medal for contribution to earth science outreach at the session, spoke on building stone as an outreach resource. Lesley Hymers of Dufferin Aggregates spoke on her company's outreach program that encourages a better understanding and awareness of the aggregate industry.

Seven talks were presented by elementary and high school educators, most of whom had received some financial support from the Canadian Geological Foundation or the Northwest Territories and Nunavut Association of Professional Engineers, Geologists and Geophysicists (NAPEGG). Their talks provided key threads for understanding the classroom environment at different grade levels and excellent insights into curriculum in various jurisdictions. Jane Londero (Vanier Catholic Secondary School, Whitehorse) gave a vivid impression of the challenges and advantages of being a geologically trained high school teacher. Linda Popoff (Hugh Cairns School, Saskatoon) described the elementary school environment, through a presentation prepared by her Grade 5/6 class. Steve Daniel (Department of Education, Culture and Employment, N.W.T.) outlined the new experiential science 10-20-30 curriculum in the territory. There is a substantial practical hands-on aspect to this curriculum and a substantial amount of earth science content. John Etches (Etches Environmental Education) described a geological mapping interpretation exercise that can be conducted on a badminton court in a school gymnasium. Again this is a hands-on activity that teaches students the importance of keen observation. Brian Briggs (Calgary Separate School District) advocated strongly for

inquiry-based learning in elementary classrooms, a theme that recurred several times in the session. Michael Jackson (St. Michael's University School, Victoria) described the use of the Seismic Eruption program in the classroom, using live links to this interactive web-based system. Erica Williams (Riverside Secondary School, Port Coquitlam) provided a critical analysis of geoscience in Kindergarten to Grade 10 curriculum in British Columbia, pointing out some serious flaws. Talks within this suite built really well on each other and provided the non-teachers in the audience with some very useful insights into elementary and secondary education.

Two talks dealt with education at the university level. Eileen van der Flier Keller gave an account of a survey of students in a first year earth science course at the University of Victoria that addressed their high school experience with earth science. Lesley Reid (University of Calgary) provided information on a study at the University of Calgary whereby students are being actively polled and interviewed on their course experience with a view to changing the way courses are taught.

Masa Goto of the National Institute for Education Policy Research in Tokyo, Japan described the development of an innovative television program for children 13-15 years of age. The program focuses on minerals, both the study of them in the field and their societal uses. It was broadcast throughout Japan.

Finally, Godfrey Nowlan addressed the state of earth science outreach in Canada, indicating that while there had been many advances in the last thirty-five years, there was still a long way to go. The small scale, high quality, hand-made products that characterize cottage industries resemble the state of earth science outreach in Canada: great quality but not very widely available. He pointed out that it is still true that most Canadians do not really appreciate where all their stuff comes from and that they remain largely unaware of how Earth processes may affect them. This presentation was an introduction to the workshop entitled *Towards an Integrated Future in Geoscience Education and Outreach* that followed the session on Saturday and Sunday 26, 27

May, 2007.

THE WORKSHOP

At 8:30 a.m. on Saturday 26 May 2007, more than thirty geoscientists and educators convened at the Prince of Wales Museum in Yellowknife to address issues related to better integration of geoscience outreach in Canada (Fig. 1). The conveners of the workshop (Godfrey Nowlan and Donna Schreiner) outlined the program for the workshop and explained that the objective was to develop a framework for activity in geoscience outreach and education over the coming decade. The workshop had originally been conceived to address the geoscience outreach needs of northern Canada and to have only participants engaged in northern outreach, but the scheduling of the Geological Association of Canada–Mineralogical Association of Canada annual meeting in Yellowknife provided a perfect opportunity to take a broader national perspective. The first item on the agenda was for individuals to introduce themselves and explain why they were attending the workshop and how they expected to be able to contribute to the proceedings. The assembled group had representatives from most regions of Canada, but the highly active groups from the Atlantic provinces were sadly not represented,

probably because of the high cost of air travel from that region to Yellowknife.

On Saturday afternoon, in the middle of the workshop deliberations, the participants took to the field (Figs. 2 and 3) for a visit to a section of superbly exposed Archean volcanic and sedimentary rocks located on the Giant mine property. The trip, ably and enthusiastically led by Al Donaldson, provided an opportunity for learning about geology and for discussion on how to convey geological ideas to the general public and in classrooms. It also afforded time for people to get to know each other better and for informal discussions of the session and first half of the workshop. The evening dinner at signature Yellowknife restaurants allowed for even more extended and animated discussions. Overall, the trip was likely a key element in the success of the workshop.

Earth Science in School Curricula

The workshop took the form of focused, open discussion around a series of questions posed by the conveners. The first question to be addressed was: *How can earth sciences increase its representation in school curriculum?*

The group first addressed the objectives of trying to get earth science



Figure 1. Workshop participants working hard at the Prince of Wales Museum.

more widely recognized in school curricula. After a wide-ranging discussion, the following reasons were identified:

- C Produce earth science literate citizens;
- C Make school students aware of earth science and its related career possibilities (resources, environment, oceans, atmosphere, hazards);
- C Attract a proportion of high school graduates into earth science-related jobs.

The reasons are a mixture of wanting all citizens to be reasonably geoscientifically literate so that they can make educated decisions locally, nationally and globally and a desire to attract the notice of potential students in geosciences. The extreme shortage of geoscientists that is anticipated as the baby boomers start to retire is a particularly compelling reason for urgency in this matter.

Then attention was turned to *how* to accomplish an increase of earth sciences in the curriculum.

The first suggestion was to get earth science “wedged” into the existing curricula for science and social studies. It was noted that a great deal of earth science lies within the geography component of the social studies curriculum in most provinces and territories and that it would not be hard for geoscientists to make significant contribution to this area of curriculum. In addition, earth science can be wedged into many aspects of the existing science curriculum, for example paleontology should be worked into that part of the biology curriculum that deals with evolution and environment. Similarly, in the effort to make science socially relevant, many of the main scientific principles have excellent examples within the earth sciences, for example Earth’s magnetic field and thermal properties in physics and the natural and anthropogenic distribution of toxic elements in environmental chemistry. All of this fits with the notion of geology as a synthetic science that uses aspects of all the other sciences.

The key actions defined for this requirement were to:

- C Become active on subject advisory committees at the provincial level;
- C Conduct a survey of earth science



Figure 2. Workshop participants on the field trip to the Giant Section on the shores of Great Slave Lake.



Figure 3. Workshop participants on the field trip to Giant Section, standing on pillow basalts.

content in existing curricula.

It was thought that these two activities are early necessities. It was agreed that the best agency to complete a study of earth sciences in Canadian curricula is the Canadian Federation of Earth Sciences (CFES) through

the Canadian Geoscience Education Network (CGEN). It was observed that an attempt was made to do this in 1995 and that a report was completed. However, the report contained some gaps and flaws due to the fact that there was a very limited budget for the

study and none available for travel. It might be easier to do now on a shoe-string budget because of the increased amount of material and references available on the internet.

The second principal suggestion was to make the importance of earth science in society known to educational authorities. The key actions defined for this requirement were:

- C Have CGEN/CFES contact ministers of education and possibly natural resources with an explanation of the importance of earth sciences and a request for an interview;
- C Engage the Prospectors and Developers Association of Canada and the Canadian Association of Petroleum Producers in approaching governments.

It was agreed that the combination of these actions immediately following the assessment of earth science content in curriculum would be a powerful follow-up.

The third principal suggestion was to improve the capacity of educators to teach and understand earth science and its associated employment opportunities. The key actions identified to achieve this goal were:

- C Professional development for teachers;
- C Professional development for school career counselors;
- C Outreach to parents;
- C CFES to support curriculum evaluation.

It was observed that the success of the EdGEO Program of Workshops for Teachers over more than thirty years has probably done a lot to improve the knowledge of teachers, but even so, much more needs to be done. It was further agreed that there had been little effort to contact high school career counselors and that there were likely many misconceptions about the opportunities for work in Canada's resource economy. It was observed that this is the domain of human resource councils, but it was agreed that much more needed to be done and that it should be driven by the professional associations and industry.

The fourth principal suggestion was to improve the profile of earth science in post-secondary institutions. Many of the academics present

bemoaned the fact that earth science was often seen as the poor relation in the science faculty and treated accordingly. Several participants observed that there is a bias against earth science even before students enter university: it is less taught in the curriculum and rarely taught in the senior part of high school. Even where it exists in senior high school curriculum (e.g. Ontario and British Columbia), it is not recognized as a valid entry science subject (teachable subject) in most universities.

Within universities, earth science is often the science subject taken by those who need a science requirement (the so-called "Rocks for Jocks syndrome"). The workshop participants saw a need to engage university career counselors in the same way as high school career counselors in order to defuse some of the myths and misunderstanding around employment in Canada's resource and environmental sectors for earth scientists.

A final and significant observation made under the discussion of the profile of earth science in universities was that earth science should be promoted as a very different science to Physics, Chemistry and Biology, in that it promotes three-dimensional skills, requires dealing with fuzzy datasets and has a strong need for teamwork. These are all desirable skills in modern society.

The key actions identified to rectify this situation were as follows:

- C Get earth science recognized as a valid entry science subject in universities;
- C CGEN/CFES contact Canadian Council of Chairs of Earth Science departments;
- C Put pressure on post-secondary to recognize earth science as a teachable subject;
- C Combat the "rocks for jocks" reputation;
- C Engage university counselors;
- C Point out unique values of ES: 3D skills, fuzzy datasets, team work.

The workshop contributors concluded that action was needed on all of the fronts identified.

The Gaps

The second major question posed to the workshop participants was: *What obvious gaps are there in the array of earth*

science outreach products and services available in Canada?

It was noted at the top of the discussion that there was no complete current inventory of outreach products or services in Canada. It was observed that EarthNet, the existing on-line database of educational items available in Canada was not well supported in most years, despite the tremendous volunteer efforts of many people, especially those affiliated with the Atlantic Geoscience Society. It was agreed that there is a strong need for an excellent, up-to-date, searchable web site that would provide a one-stop shop for those engaged in earth science outreach and education.

In this context it was noted that Canadian earth science outreach efforts are almost completely volunteer in nature. There is really no supply of paid people to complete such inventories and maintain them. It was agreed that this may be the largest single stumbling block to improvement in the availability and promotion of earth science outreach materials in Canada.

One of the major gaps identified is the lack of a current careers web site. It was noted that there had been excellent booklets produced by the Canadian Geoscience Council (the forerunner of the Canadian Federation of Earth Sciences) but these were now dated and out of print. The CD/web site developed as its replacement was likewise deemed to be dated. Therefore there was strong support for a new interactive earth science career web site as one of the key requirements in the near future. Workshop participants were heartened to learn that CFES/CGEN are currently developing a new Careers in Earth Science web site that will be launched by early 2008 at the latest, as part of the program emanating from the International Year of Planet Earth.

Another gap identified was the general lack of geoscience outreach products related to tourism. A number of notable exceptions were identified such as the Nova Scotia Rocks brochures that are distributed at tourist stops in Nova Scotia and geological highway maps that are available to tourists in some provinces (e.g. Saskatchewan). It was recognized that there are many new opportunities for

travel brochures, improved signage in parks and narrations on radio and satellite navigation systems.

It was also noted that there is a general lack of geoscience-related programming on television. One suggestion was something along the lines of the old but successful Hinterland Who's Who. It was noted that the Canadian Broadcasting Corporation and the National Film Board have produced a five-part TV series called A Geologic Journey. At the time of writing, this program is being aired and is co-sponsored by the International Year of Planet Earth.

A subject that received considerable discussion was the general lack of good interpretation of geological features in national and provincial parks. It seems that most park interpreters are biologists and that there needs to be an increase in earth science trained people in park interpretation. There was a short discussion of the new concept of Geoparks that is being promoted by UNESCO and all agreed, these represented an opportunity in Canada, especially in regions without major tourist traffic at present.

There was also a brief discussion of the internet as a tool for earth science outreach. The suggestions were for going beyond the traditional educational web site to embrace interactive opportunities such as exist on Face Book and a variety of other chat rooms.

The integration of earth science outreach initiatives into environmental initiatives was advocated by some workshop participants. They noted that "green" initiatives are commonly well funded and that they represent major opportunities for earth science outreach. Links to existing environmental groups such as River Keepers were also encouraged as a way of linking earth science to the community.

This wide-ranging discussion of the gaps in earth science outreach led to a host of suggestions for action:

- C Complete an exhaustive inventory of existing earth science outreach products;
- C Promote existing products more effectively;
- C Build a careers-related web site as soon as possible;
- C Create a one-stop shop for all

earth science outreach materials; build on the example of EarthNet or establish a new shop that is well funded;

- C Find a way to hire people to conduct and maintain the inventory of earth science outreach products and to promote them;
- C Establish more links to tourism: travel brochures, road-side signage, radio narrations, satellite navigation content;
- C Broaden the presence of earth science in television;
- C Get earth science interpretation (back) into National and Provincial Parks by establishing contacts with the interpretation community and providing workshops for park interpreters;
- C Establish contacts with parks to encourage employment of earth scientists;
- C Establish internet-based initiatives on interactive media such as Face Book and chat rooms;
- C (Re)Establish contacts with environmental, heritage and historic societies to explore linkages within them for earth science outreach;
- C Promote stronger links between earth sciences, education and corporations;
- C Attach outreach efforts to "green" initiatives which are commonly funded.

Reorganization of Outreach

The final question posed to the workshop participants was: *How can we reorganize earth science outreach in Canada in order to accomplish more funded outreach in government, academe and industry?*

There was a general discussion of the need for some sort of infrastructure to support earth science outreach in Canada. It was acknowledged that some paid people exist in organizations such as museums and science centres and that perhaps they might be a starting point for establishing a permanent office of public outreach. It was also noted that some of the "issues" in earth sciences, such as natural hazards (e.g. earthquake awareness) may have paid people. Some thought that there might be people within geological surveys for whom outreach was at least a partial responsibility. Despite all these potential resource people, it was

acknowledged that there really is a need for an office somewhere in which there are people whose responsibility it is to complete and maintain inventories of outreach products, research the effectiveness of various outreach approaches, and play a role in developing new products. Such an office does not exist at present. There used to be a limited office in the Geological Survey of Canada in Ottawa a number of years ago but it has been superseded by communications offices that more directly serve the needs of the minister and not science in general.

It was therefore agreed that there is a need for an independent office of earth science outreach with perhaps 1.5 FTE as a start to begin the process of providing a framework for all the volunteer efforts in earth science outreach that are currently under way. The workshop participants considered the following actions required to achieve this goal:

- C Establish a CGEN/CFES Office of Earth Science Outreach with 1.5 full time employees by raising funds to pay salaries for staff and producing a work plan;
- C Encourage professional secondments from industry, government and academe to the new office.

As a supplement to this office, all reasonable use should be made of existing professionals in other institutions to focus their efforts collectively on earth science awareness by:

- C Partnering with existing professional labour in museums and science centres;
- C Using provincial geotourism coordinators where they exist;
- C Partnering with staff in geological surveys and universities who may from time to time have some outreach responsibilities.

Once this office is established, the workshop participants identified the need for a survey of earth science awareness in Canada, along the lines of the science literacy surveys conducted in the 1990s. This would establish a baseline of awareness against which future progress can be measured and future plans can be made. Some initial actions could set this process in motion:

- C Contact CFES/professional survey agencies/media outlets to gauge

interest

- C Conduct studies of the effectiveness of existing outreach programs such as EdGEO and Geoscape posters;
- C Contact the NSERC Crystal Project for potential partnerships.

CONCLUSIONS

The workshop held in Yellowknife in May 2007 was the largest assembly of earth science outreach experts to have met in Canada to date. Through the intensive deliberations of this group an action plan for the future of earth science outreach in Canada has been clearly laid out. It involves several parallel thrusts: a move from the entirely volunteer efforts at present to establishment of a funded office to ensure that the framework of earth science outreach is maintained and volunteers do not burn out; an expansion of the existing efforts in earth science outreach, particularly to teachers, career counselors, parents and decision makers; a more prominent role for earth sciences in school curricula. A first draft of the detailed actions required to effect these changes are contained in this document and it serves as a starting point for the reformation, reorganization and reinvigoration of earth science outreach in Canada. The coming of the International Year of Planet Earth (2007-2009) should provide a wonderful catalyst for the achievement of some of the goals identified in this report.

The conveners of this session would like to thank the participants for their tremendous energy during the session and workshop. They would also like to thank the Canadian Geological Foundation and the Northwest Territories and Nunavut Association of Professional Engineers, Geologists and Geophysicists for their financial support for teachers attending this session and workshop. Thanks are also due to the Canadian Geoscience Education Network for their support of refreshments during the workshop.

APPENDIX: List of participants in the workshop *Towards an Integrated Future in Geoscience Education and Outreach*, held in Yellowknife, 26, 27 May, 2007

Jan Aylsworth	(Geological Survey of Canada, Ottawa)
Diane Baldwin	(NWT Geoscience Office, Yellowknife)
Charly Bank	(Department of Geology, University of Toronto)
Catherine Barrett	(Canadian Federation of Earth Sciences, Calgary)
Brian Briggs	(Calgary Catholic School Division)
Kate Bruce	(Yellowknife Catholic School Board, Aurora College)
Laura Clinton	(PDAC Mining Matters, Toronto)
Steven Daniel	(Govt. of N.W.T., Dept. of Education, Yellowknife)
Tania Demchuk	(School of Earth & Ocean Sci., Univ. of Victoria)
Allan Donaldson	(Geoheritage Canada, Ottawa)
Jon Dudley	(Canadian Natural Resources, Calgary)
Dixon Edwards	(Alberta Geological Survey, Edmonton)
John Etches	(Etches Environmental Education, Lakefield, ON)
Fran Haidl	(Saskatchewan Industry and Resources, Regina)
Linda Ham	(Indian and Northern Affairs Canada, Iqaluit)
Russell Hartlaub	(British Columbia Institute of Technology, Burnaby)
Brian Hitchon	(Geoscience Publishing, Edmonton)
David Huntley	(Geological Survey of Canada, Calgary)
Mike Jackson	(St. Michael's University School, Victoria)
Larry Lane	(Geological Survey of Canada, Calgary)
Karen Lochhead	(DocMatrix Canada, Gatineau, QC)
Gayla Meredith	(Yellowknife Education District No. 1)
Ward Neale	(Retired geologist, Calgary)
Godfrey Nowlan	(Geological Survey of Canada, Calgary)
Linda Popoff	(Hugh Cairns School, Saskatoon)
Donna Schreiner	(N.W.T. Geoscience Office, Yellowknife)
Eileen van der Flier Keller	(School of Earth & Ocean Sci., Univ. of Victoria)
Christy Vodden	(Canadian Geoscience Education Network, Ottawa)
Miriam Vos-Guenter	(Belmont Secondary School, Victoria)
Erica Williams	(Coquitlam School Division, B.C.)
Ian Young	(Can. Federation of Earth Sciences, Encana, Calgary)

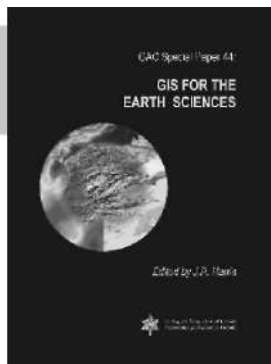


\$[eW Publications From the Geological Association of Canada

Structural thinking: a key to mineral deposit studies in deformed terrain: PowerPoint

Shoufa Lin, 2005, CD, ISBN: 978-1-897095-27-0

An easy-to-navigate CD containing the GAC Hutchison Medallist Lecture Tour material from the 2004-05 presentations by accomplished scientist Shoufa Lin. Suitable for classroom instruction.

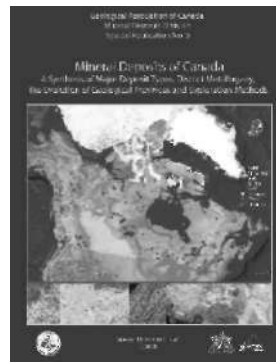


SP 44: GIS For the Earth Sciences

Jeff Harris, 2006, 632 p. + CD + 3-D glasses, ISBN: 978-0-919216-96-9

This volume provides many examples of how a Geographic Information System (GIS) in concert with other software (statistical, image analysis) can be useful for addressing various earth science applications that involve spatial analysis of a wide range of geoscience datasets. Examples include mineral resource assessment, analysis and visualization of multi-media geochemical data, geologic mapping, natural hazards assessment and environmental applications.

A collection of 44 papers grouped under five major headings. Part I is an overview of the economic value of mineral resources in Canada; Part II provides a current synthesis of economically important deposit-types in Canada; Part III describes the metallogeny of economically important Canadian mining camps; Part IV documents the geological evolution and metallogeny of geological provinces in Canada; and Part V covers geophysical and geochemical exploration methods.



Fine Wine and Terroir: The Geoscience Perspective

R.W. Macqueen and L.D. Meinert, 2006, 266 p., ISBN: 978-1-897095-21-8

This collection of articles, mainly from the quarterly journal *Geoscience Canada*, covers a wide range of topics in more than a dozen viticultural regions on three continents. Tying these studies together is the application of basic science to better understand the physical environment affecting grape and wine quality. These articles provide a series of benchmarks critical to understanding terroir in existing vineyards, and a firm foundation for future terroir studies.

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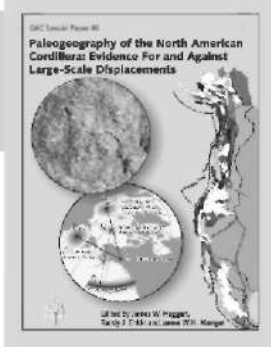
\$[eW Publications From the Geological Association of Canada

Modern and ancient clastic sedimentary environments:

A collection of field photographs

D.GE Long and J.A. Donaldson, 2005, CD, ISBN: 1-897095-04-X

Navigate through hundreds of slide-quality photographs representing all major aspects of modern and ancient sedimentary environments. Suitable for classroom instruction - a must-have for earth-science educators.



SP 46: Paleogeography of the North American Cordillera: Evidence For and Against Large-Scale Displacements

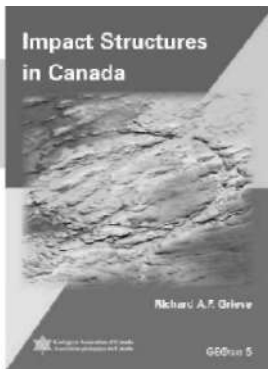
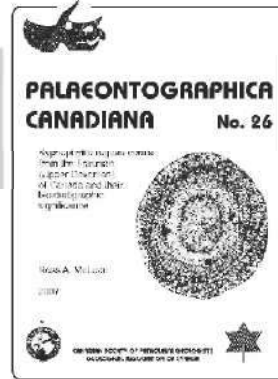
J. Haggart, R.J. Enkin and J.W.H. Monger, 2006, 429 p., ISBN: 978-1-897095-14-0

The North American Cordillera has experienced a dramatic history of tectonic and paleogeographic evolution over the past 400 million years and is the birthplace of the accreted, or "suspect," terrane concept. Much of the western part of the Cordillera is composed of crustal fragments which have been shuffled along the continental margin, or across vast oceanic basins, or both.

PalCan 26: Kyphophyllid rugose corals from the Frasnian (Upper Devonian) of Canada and their biostratigraphic significance

Ross A. McLean, 2007, 109 p., ISBN: 978-1-897095-00-3

Corals are a common and highly visible component of the Devonian strata of western and northern Canada. This volume describes representatives of the Rugose coral family Kyphophyllidae from Upper Devonian (Frasnian). Sixteen species (six of which are new), from three genera (one of which is new) are described and illustrated.



GEOtext 5: Impact Structures in Canada

R.A. Grieve, 2006, 219 p., ISBN: 1-897095-11-2

This book compiles, synthesizes and distills the knowledge base from published and unpublished data and information from the extensive program of study of Canadian impact structures, the program's partners and from other researchers. It represents a time-slice of integrated knowledge on Canadian impact structures, as it stands today.

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