Chris Holmden CV, 2015

Professor and Co-Director of the Saskatchewan Isotope Laboratory (http://sil.usask.ca)
Department of Geological Sciences
University of Saskatchewan
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Canada
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Education

Ph.D., University of Alberta, 1995, Department of Geology
B.Sc. (Honours), 1990, McMaster University, Department of Geology

Birth and Citizenship

11/11/1962, Kingston, Ontario, Canada

Graduate Advisors

Karlis Muehlenbachs (1990–1995, University of Alberta)
Robert Creaser (1993–1995, University of Alberta)

Professional Experience

2015—Visitor in Geochemistry, California Institute of Technology, Pasadena, CA (March–April)
2015—Visiting Scholar, UC Riverside, Riverside, CA (January–February)
2007—Appointed Professor, Dept. of Geological Sciences, University of Saskatchewan
2003—Visiting Scientist, Universidad de Nacional de Mexico, Institute de Ciencas de Limnilogia del Mar
2004—Visitor in Geochemistry, California Institute of Technology, Pasadena, CA
1998—Appointed Associate Professor, Dept. of Geological Sciences, University of Saskatchewan
1996—Appointed Assistant Professor, Dept. of Geological Sciences, University of Saskatchewan
1995-96—Postdoctoral Fellow, California Institute of Technology

Publications (student authors in bold type)

Manuscripts submitted or in preparation for refereed journals

1. Holmden C., Jacobson A.D., Sageman B., and Hurtgen M. Response of the Cr isotope proxy to Ocean Anoxic Event 2. Submitted to *Geochim. Cosmochim. Acta*, June 30, 2015.

Papers published in refereed journals

2. **Scheiderich, K.**, **Amini M.,** Holmden, C., and Francois R. (2015) Global variability of chromium isotopes in seawater demonstrated by Pacific, Atlantic and Arctic Ocean samples. *Earth Planet. Sci. Lett*. 423, 87–97.

3. Jacobson A.D., **Andrews M.G**., **Lehn G.O**., and Holmden C. (2015) Silicate versus carbonate weathering in Iceland: New insights from Ca isotopes. *Earth Planet. Sci. Lett*. 416, 132–142.
4. Holmden C., **Amini M.,** and Francois R. (2015) Uranium isotope fractionation in Saanich Inlet: a modern analog study of a paleoredox tracer. *Geochim. Cosmochim. Acta.* 153, 202–215
5. Melchin M., Mitchell C.E., Holmden C., and Storch P. (2013) Environmental changes in the Late Ordovician–early Silurian: Review and new insights from black shales and nitrogen isotopes. *Geol. Soc. Amer. Bull.* 125, 1635–1670.
6. **Worsham S.R**., Holmden C., and Qing H. (2013). Preliminary results of a Mg isotope study of dolomite in the Upper Ordovician strata, Southeastern Saskatchewan, Northern Williston Basin. *in* Summary of Investigations 2013, Volume 1, Saskatchewan Geological Survey, Sask. Ministry of the Economy, Misc. Rep. 2013-4.1, Paper A-9, 8p.
7. **Lehn G.,** Jacobson A.D., and Holmden C. (2013) Precise analysis of Ca isotope ratios ($\delta^{44/40}$Ca) using an optimized ^{43}Ca-^{42}Ca double-spike MC-TIMS method. International Journal of Mass Spectrometry doi.org/10.1016/j.ijms.2013.06.013
8. Holmden C., Mitchell C., **LaPorte D.L**., Patterson W.P., Melchin M.J., and Finney S. (2013) Nd isotope records of late Ordovician sea-level change—Implications for glaciation frequency and global stratigraphic correlation. *Palaeogeo. Palaeoclim. Palaeoecol*. 286, 131–144.
9. **Moore J**., Jacobson A.D., Holmden C., and Craw, D. Tracking the relationship between uplift, silicate weathering, and long-term CO_2 consumption with Ca isotopes: Southern Alps, New Zealand. Submitted to *Chem. Geol*. 341, 110–127.
10. Holmden C., Panchuk K., and Finney S.C. (2012) Tightly coupled records of Ca and C isotope changes during the Hirnantian glaciation in an epeiric sea setting. *Geochim. Cosmochim. Acta.* 98, 94–106.
11. Holmden C., Papanastassiou D.A., Blanchon P., and Evans S. (2012) $\delta^{44/40}$Ca variability in shallow water carbonates and the impact of submarine groundwater discharge on Ca-cycling in marine environments. *Geochim. Cosmochim. Acta* 83, 179–194
12. Sheets H.D., Mitchell C., Melchin M.J., Finney S.C., and Holmden, C. (2012) Horizon Annealing: A collection-based approach to automated sequencing of the fossil record. *Lethaia* 45, 532–547.
13. Fantle M.S., Tollerud H., Eisenhauer A., and Holmden C. (2012) The Ca isotopic composition of dust-producing regions: Measurements of surface sediments in the Black Rock Desert, Nevada. *Geochim. Cosmochim. Acta* 87, 178–193.
14. Belanger N., Holmden C., Courchesne F., Benoit C., and Hendershot W.H. (2012) Constraining soil mineral weathering ^{87}Sr/^{86}Sr for calcium apportionment studies of a deciduous forest growing on soils developed from granitoid igneous rocks. *Geoderma* 185, 84–96.
15. **Ryu J-S**, Jacobson AD, Holmden C., Lundstom C., and Zhaofeng Z. (2011) The major ion, $\delta^{44/40}$Ca, $\delta^{44/42}$Ca, and $\delta^{26/24}$Mg geochemistry of granite weathering at pH = 1 and T = 25°C: power-law processes and the relative reactivity of minerals. *Geochim. Cosmochim. Acta* 75, 6004–6026.
16. Bélanger N., and Holmden C. (2010) Influence of landscape on the apportionment of Ca nutrition in a Boreal Shield forest of Saskatchewan (Canada) using ^{87}Sr/^{86}Sr as a tracer. *Canadian Journal of Soil Science* 90, 267–288.

17. **Huang F., Chakraborty P**., Lundstrom C.C., Holmden C., Glessner J.J.G., Kieffer S., and Lesher C.E. (2010) Isotope fractionation in silicate melts by thermal diffusion. *Nature* 464, 396–400.
18. Patterson W.P., **Dietrich K.A**, Holmden C., and Andrews J.T. (2010) Two millennia of North Atlantic seasonality and implications for Norse colonies. *Proceedings of the National Academy of Sciences* 107, 5306–5310.
19. Holmden C., and Bélanger N. (2010) Ca isotope cycling in a forested ecosystem. *Geochim. Cosmochim. Acta* 74, 995–1015.
20. Holmden C. (2009) Ca isotope study of Ordovician dolomite, limestone, and anhydrite in the Williston Basin: Implications for subsurface dolomitization and local Ca Cycling. *Chemical Geology* 268, 180–188.
21. **LaPorte D.F**., Holmden C., Patterson W.P.,' **Loxton J.D**., Melchin M.J., Mitchell C., Finney S.C., and Sheets H.D. (2009) Local and global perspectives on carbon and nitrogen cycling during the Hirnantian Glaciation, *Palaeogeography, Palaeoclimatology, Palaeoecology* 276, 182-195.
22. **LaPorte D.F**., Holmden C., Patterson W.P., Prokopiuk T., and Eglington B.M. (2009) Oxygen isotope analysis of phosphate: Improved precision using TC/EA-IRMS. *Journal of Mass Spectrometry* 44, 879–890.
23. **Amini M**., Eisenhauer A., Böhm F., Holmden C., Kreissig K., Hauff F., and Jochum K.P. (2009) Calcium isotopes ($\delta^{44/40}$Ca) in MPI-DING reference glasses, six USGS rock powders and various rocks: evidence for Ca isotope fractionation in terrestrial silicates. *Geostandards Newsletter* 33, 231–247.
24. Bekker A., Holmden C., Beukes N.J., Kenig F., Eglington B., and Patterson W.P. (2008) Fractionation between inorganic and organic carbon during the Lomagundi (2.22–2.1 Ga) carbon isotope excursion. *Earth Planet. Sci. Lett.* 270, 278–291.
25. Jacobson A.D., and Holmden C. (2008) d^{44}Ca evolution in a carbonate aquifer and its bearing on the equilibrium isotope fractionation factor for calcite. *Earth Planet. Sci. Lett.* 270, 349–353. v. 270, p. 349-353.
26. Immenhauser A., Holmden C., and Patterson W.P. (2008) Interpreting the carbon-isotope record of ancient shallow epeiric seas: lessons from the Recent. In, Dynamics of Epeiric Seas. Edited by B.R. Pratt and C. Holmden, Geological Association of Canada Special Paper 48 p. 137–174.
27. **Cosford J**., Qing H., Yuan D., Zhang M., Holmden C., Patterson W.P., and Hai C. (2008) Millennial-Scale Variability in the Asian Monsoon: evidence from oxygen isotope records from stalagmites in southeastern China. *Palaeogeography, Palaeoclimatology, Palaeoecology* 266, 3–12.
28. **Dodd J.P**., Patterson W.P., Holmden C., and **Brasseur J.M**. (2008) Robotic micromilling of tree-rings: A new tool for obtaining subseasonal environmental isotope records. *Chemical Geology* 252, 21–30.
29. **Diefendorf A.F**., Patterson W.P., Holmden C., Mullins H.T., and O'Connell M. (2008) Carbon isotopes of marl and organic lake sediment record terrestrial landscape change during the late glacial and early Holocene (16,800 to 5,540 cal yr BP): a multiproxy study of lacustrine sediments at Loch Inchiquin, western Ireland. *Journal of Paleolimnology* 39, 101–115.

30. **Dufour E**., Holmden C., Van Neer W., Zazzo A., and Patterson W.P. (2007) Oxygen and strontium isotopes as provenance indicators of fish at archaeological sites: the case study of Sagalassos, SW Turkey. *Journal of Archaeological Science* 34, 1226–1239
31. **Fanton K.C.,** and Holmden C. (2007) Sea level forcing of carbon isotope excursions in epeiric seas: implications for carbon isotope chemostratigraphy. *Canadian Journal of Earth Science* 44, 807–818.
32. Mitchell C.E., Sheets H.D., Belscher K., Finney, S.C., Holmden C., **LaPorte D.F**., Melchin M.J., and Patterson W.P. (2007) Species abundance changes during mass extinction and the inverse Signor-Lipps Effect: Apparently abrupt graptolite mass extinction as an artifact of sampling. In: Proceedings of the 10th International Symposium on the Ordovician System, Nanjing, China, June 2007, Jun Li and Fan Junxuan (eds). *Acta Palaeontologica Sinica* 46, 340–346.
33. Jacobson A.D., and Holmden C. (2006) Calcite dust and the atmospheric supply of Nd to the Japan Sea. *Earth and Planetary Science Letters* 244, 418–430.
34. Melchin M.J., and Holmden C. (2006) Carbon isotope chemostratigraphy of the Landovery in Arctic Canada: implications for global correlation and sea level change. *GFF* 128, 173–180.
35. **Jensen G. K. S.,** Rostron B. J., Duke M. J. M., and Holmden C. (2006) Chemical profiles of formation waters from Potash mine shafts, Saskatchewan. In Summary of Investigations 2006, volume 1, Saskatchewan Geological Survey, Saskatchewan Industry and Resources, Miscellaneous Report 2006-1, CD-ROM, Paper A-7, 8p.
36. Holmden C., Braun W., Patterson W.P, Eglington B.M., Prokopiuk T.C., and Whittaker S. (2006) Carbon isotope chemostratigraphy of Frasnian sequences in Western Canada. Summary of Investigations 2006, volume 1, Saskatchewan Geological Survey, Saskatchewan Industry and Resources, Miscellaneous Report 2006-4.1,CD-ROM Paper A-8, 6p.
37. **Jensen G.K.S**., Rostron B.J., Duke M.J.M., and Holmden C. (2006) Bromine and stable isotopic profiles of formation waters from potash mine-shafts, Saskatchewan, *Canadian Journal of Geochemical Exploration* 89, 170–173.
38. Melchin M.J., and Holmden C. (2005) Carbon isotope chemostratigraphy in Arctic Canada: Sea level forcing of carbonate platform weathering and implications for Hirnantian global correlation. *Palaeogeography, Palaeoclimatology, Palaeoecology* 234, 186–200.
39. **Panchuk K. M**., Holmden C., and Kump L. R. (2005) Sensitivity of the epeiric sea C-isotope record to local-scale C-cycle processes: Tales from the Mohawkian Sea. *Palaeogeography, Palaeoclimatology, Palaeoecology* 228, 320–337.
40. **Panchuk K. M**., Holmden C., and Leslie S. A. (2005) Local controls on carbon cycling in the Ordovician Midcontinent region of North America with implications for carbon isotope secular curves. *Journal of Sedimentary Research* 76, 200–211.
41. Holmden C. (2005) Measurement of $d^{44}Ca$ using a ^{43}Ca-^{42}Ca double-spike TIMS technique. In Summary of Investigations 2003, volume 1, Saskatchewan Geological Survey, Saskatchewan Industry and Resources, Miscellaneous Report 2005-1,CD-ROM, Paper A-4 7p.
42. Noble P. J., **Zimmerman M. K**., Holmden C., and Lenz A. C. (2005) Early Silurian (Wenlockian) $d^{13}C$ profiles from the Cape Phillips Formation, Arctic Canada, and its relation to biotic events. *Canadian Journal of Earth Sciences* 42, 1419–1430.

43. **Young S.A**., Saltzman M.R., Bergstrom S.M., Holmden C., and Patterson W.P. (2003) Paleoceanographic aspects of the Early Chatfieldian (Upper Middle Ordovician): Positive $\delta^{13}C$ excursion (GICE). *Oklahoma Geology Notes* 63, no. 3, p. 126.
44. Holmden C., and Hudson J. D. (2003) $^{87}Sr/^{86}Sr$ and Sr/Ca investigation of Jurassic molluscs from Scotland: Implications for paleosalinities and the Sr/Ca ratio of seawater. *Geological Society of America Bulletin* 115, 1249–1264.
45. Melchin M. J., Holmden C., and Williams S.H. (2003) Correlation of graptolite biozones, chitinozoan biozones, and carbon isotope curves through the Hirnantian. In Albanesi G.L., Beresi, M.S. and Peralta, S.H. (eds.). *INSUGEO, Srie Correlacion Geologica* 17, 99–102.
46. Haidl F.M., Holmden C., Nowlan G.S., and **Fanton K.C.** (2003) Preliminary report on conodont and Sm-Nd isotope data from Upper Ordovician Red River strata (Herald and Yeoman Formations) in the Williston Basin, Berkley et al. Midale 12-2-7-11W2, Southeastern, Saskatchewan: In Summary of Investigations 2003, volume 1, Saskatchewan Geological Survey, Saskatchewan Industry and Resources, Miscellaneous Report 2003-4.1, CD-ROM, PaperA-1, 13p.
47. Rostron B.J., and Holmden C. (2003) Regional variations in oxygen isotopic compositions in the Yeoman and Duperow aquifers, Williston basin (Canada-USA) *Journal of Geochemical Exploration* 1, 1–5.
48. **Fanton K.C.,** Holmden C., Nowlan G.S., and Haidl F.M. (2002) $^{143}Nd/^{144}Nd$ and Sm/Nd stratigraphy of Upper Ordovician epeiric sea carbonates. *Geochim. Cosmochim. Acta* 66, 241–255.
49. Rostron B.J., Kelley L.I., Kreis L.K., and Holmden C. (2002) Economic potential of formation brines: Interim results from the Saskatchewan brine sampling program: In Summary of Investigations 2002, Volume 2, Saskatchewan Geological Survey, Sask. Industry Resources, Misc. Rep. 2002-4.2, CD-ROM, Paper C-1, 29p.
50. Kelley L., and Holmden C. (2001) Reconnaissance hydrogeochemistry of economic deposits of sodium sulfate in saline lakes, Saskatchewan, Canada. *Hydrobiologia* 466, 279–289.
51. Kelley L.I., and Holmden C. (2001) Semi-quantitative assessment of groundwater flux from H, O and Sr isotopes, Lydden Lake sodium sulphate deposit: In Summary of Investigations, 2001, Volume 2, Saskatchewan Geological Survey, Sask. Energy and Mines, Misc. Report, 2001, 4-2, p. 173-184.
52. Rostron B.J., and Holmden C. (2000) Fingerprinting formation-waters using stable isotopes, Midale Area, Williston Basin, Canada. *J. Geochem. Explor.* 69–70, 219–223.
53. Kelley L.I., and Holmden C. (1999) Reconnaissance study of strontium isotopic composition of lake brines and groundwater associated with sodium sulphate deposits, southern Saskatchewan: In Summary of Investigations 1999, Volume 2, Saskatchewan Geological Survey, Saskatchewan Energy and Mines, Misc. Rep. 99-4.2.
54. Holmden C., Creaser R. A., Muehlenbachs K., Leslie S., and Bergstrom S.M. (1998) Isotopic evidence for geochemical decoupling between ancient epeiric seas and bordering oceans: Implications for secular curves. *Geology* 26, 567-570.
55. Kelley L.I., Smith J.J., and Holmden C. (1998) Stable isotope and chemical composition of groundwater associated with sodium sulphate deposits, southern Saskatchewan: In Summary of Investigations 1998, Saskatchewan Geological Survey, Saskatchewan Energy and Mines, Misc.

Rep. 98-4

56. Rostron B.J., Holmden C. and Kreis L.K. (1998) Hydrogen and oxygen isotope compositions of Cambrian to Devonian formation waters, Midale area, Saskatchewan: In Christopher, J.E., Patterson, D.F. and Bend, S.L. eds., Eighth International Williston Basin Symposium, Saskatchewan Geological Society Special Publication No. 13.
57. Holmden C., Muehlenbachs K., and Creaser R.A. (1997) Depositional paleoenvironment of the early Cretaceous Ostracode Zone: Paleohydrologic constraints from O, C and Sr isotopes. In, Petroleum Geology of the Cretaceous Mannville Group, Western Canada. Eds. S.G. Pemberton and D.P. James. Canadian Society of Petroleum Geologists, Memoir 18.
58. Holmden C., Papanastassiou D.A., and Wasserburg G.J. (1997) Negative thermal ion mass spectrometry of oxygen in phosphates. *Geochim. Cosmochim. Acta* 61, 2253–2263.
59. Holmden C., Creaser R.A., and Muehlenbachs K. (1997) Paleosalinities in ancient brackish water systems determined by $^{87}Sr/^{86}Sr$ ratios in carbonate fossils: A case study from the Western Canada Sedimentary Basin. *Geochim. Cosmochim. Acta* 61, 2105–2118.
60. Holmden C., Creaser R.A., Muehlenbachs K., Bergstrom S.M., and Leslie S.A. (1996) Isotopic and elemental systematics of Sr and Nd in 454 Ma biogenic apatites: Implications for paleoseawater studies. *Earth and Planetary Science Letters* 142, 425–437.
61. Holmden C., and Dickin A.P. (1995) Paleoproterozoic crustal history of the southwestern Grenville Province: evidence from Nd isotopic mapping. *Canadian Journal of Earth Sciences*, 32, 472–485.
62. Holmden C., and Muehlenbachs K. (1993) $^{18}O/^{16}O$ ratio of 2-billion-year-old seawater inferred from ancient oceanic crust. *Science* 259, 1733–1736.

Books and chapters in books

1. Noble P.J., Lenz A.C., Holmden C., Masiak M., Zimmerman M.K., Poulson S.R., and Koslowska A. 2012. Isotope geochemistry and plankton response to the Ireviken (Earliest Wenlock) and Cyrtograptus lundgreni extinction events, Cape Phillips Formation, Arctic Canada. In: J.A. Talent (ed.), Global Biodiversity, Extinction Intervals, and Biogeographic Perturbations Through Time, Earth and Life, International Year of Planet Earth Series, Springer, p. 631-652.
2. Mitchell C.E., Storch P., Holmden C., Melchin M.J., and Gutierrez-Marco J.C. (2011) New stable isotope data and fossils from the Hirnantian strata in Bohemiz and Spain: Implications for correlation and paleoclimate. In, J.C. Gutierrez-Marco, I. Rabano and D. Garcia-Bellido (eds.), Ordovician of the World. Cuadernos del Museo Geominero, 14. Instituto Geologica y Minero de Espana, Madrid. ISBN 978-94-7840-857-3. 8 pages.
3. Dynamics of Epeiric Seas, Edited by, Pratt B.R., and Holmden C., Special Paper 48, Geological Association of Canada, 14 invited papers, 406 pages.

Invited Talks (student authors in bold type)

2014-2015

- Holmden C., Scheiderich K., Amini M. and Francois, R. Cr isotope variability in the

oceans: implications for the Cr isotope proxy. Invited talk: Goldschmidt Geochemistry Conference 2015, Prague, Czech Republic.

- Holmden, C. Tightly coupled records of C and Ca isotope changes during the Hirnantian glaciation. Invited Talk. UC Riverside, January 16, 2015.

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2012-2013

- Holmden C., and Bekker A. Tracing the rise of atmospheric oxygen using Cr isotopes in carbonates as a paleoredox proxy. Invited talk: Goldschmidt Geochemistry Conference 2013, Florence, Italy.
- Holmden C. Tightly coupled records of C and Ca isotope changes during the Hirnantian glaciation. Invited Talk: Northwestern University, Department of Geological Sciences April 7, 2013.

2011-2012

- **Worsham S**., Holmden C., and Belanger N. Magnesium isotope fractionation in a hardwood forest of southern Quebec. Goldschmidt Annual Meeting, Prague, 2011, p. 2178.
- Holmden C. Calcium isotopes in wine. Annual Fall Meeting, San Francisco, 2011, V13A-2588.
- Holmden C., Panchuk K., and Finney SC. Calcium and Carbon isotope changes during the Hirnantian glaciation event in an epeiric sea setting. AGU Annual Fall Meeting, San Francisco, 2011, PP41E-04.

2008-2009

- Holmden C. Ca isotope cycling in a boreal forest ecosystem. University of Wyoming.
- Holmden C. Carbon and nitrogen cycling during the Hirnantian glaciation. Stanford University.
- Holmden, C. Carbon isotope gradients on early Paleozoic platforms. AGU 2008 Fall Meeting. PP31D 04

2006-2007

- Holmden C. $d^{44}Ca$ cycling in a boreal forest ecosystem. University of Michigan at Ann Arbor.

2005-2006

- Holmden C. The relationship between sea level and Sm-Nd and C isotope chemostraigraphy in epeiric sea successions. Great Lakes SEPM Field Conference, Decorah, Iowa.

2004-2005

- Holmden C. Sea level control of C and Nd isotope chemostratigraphy in epeiric seas. Northwestern University, April 08, 2005.
- Holmden C. The relationship between sea level, Sm/Nd and C-isotope chemostratigraphy in epeiric sea successions. University of Western Ontario, Feb 18, 2005.

2002-2003

- Holmden C. The epeiric seas: Clues and views from the isotopic perspective. University of Iowa, Dec 6, 2002.

2001-2002

- Holmden C. The Saskatchewan Isotope Laboratory, presented to the Geological Society of Saskatchewan, Regina, October, 2001.

- Holmden C. Origin of sodium sulphate deposits of Saskatchewan: Tracer potential of strontium isotopes. Saskatchewan Energy and Mines Annual Open House, Delta Bessborough Hotel, Saskatoon, Nov. 28, 2001.

2000-2001

- Holmden C. Epeiric sea C-cycling. Canadian Institute for Advanced Research, Dec. 2-4, Sainte Adele, Quebec.
- Rostron B.J., Kreis L.K., and Holmden C. Economic minerals in Saskatchewan brines: Preliminary results. Saskatchewan Energy and Mines, Open House, Saskatoon, Saskatchewan, November 27-29th.

1999-2000

- Holmden C. Hydrogen and oxygen isotope systematics of formation waters in the Williston Basin, presented at Saskatchewan Energy and Mines Open House, Fall, 1999.
- Holmden C. Influence of epeiric seas on past seawater isotope signatures, Canadian Institute for Advanced Research, Calgary, June 04, 2000.

1998-1999

- Kelley L., Smith J., and Holmden C. Stable isotopes and chemical composition of groundwater associated with sodium sulphate deposits, southern Saskatchewan. Saskatchewan Energy and Mines Open House, December 1, 1998, Bessborough Hotel, Saskatoon

1992-1993

- Holmden C., and Muehlenbachs K. Oxygen isotope evidence for Phanerozoic-style seawater ocean-crust interaction in the Early Proterozoic, EOS v. 73, V32B-10

Research Grant Information

2015

- $4000—NSERC USRA (Holmden PI) Summer research support for Jonathon Toma

2014

- $258,000—NSERC Discovery Grant (Holmden PI) Earth's changing environment and life through time: a geochemical perspective (100% of funds).

2013

- $4,997,855—NSERC Climate and Atmospheric Research Program (Roger Francois PI and 18 others) The Canadian Arctic GEOTRACES program: Biogeochemical and tracer study of a rapidly changing Arctic Ocean (3% of funds).
- $30,000—Province of Saskatchewan (Holmden PI). Mg isotope study of dolomite (100% of funds).

2011

- $149,480—CFI Leaders Opportunity Award (Holmden PI) High performance ion chromatography support for non-traditional stable isotope research (100% of funds)

2010

- $5600— NSERC USRA (Holmden PI) Summer research support for Britni Brenna

2008

- $3,926,155—NSERC/IPY (Roger Francois PI and 12 others) GEOTRACES: Multi-tracer investigation of the effect of climate change on nutrient and carbon cycles in the Arctic Ocean (6.1% of funds)
- $300,000—Talisman Energy Inc. (Patterson PI, with Holmden) Paleoclimate research (100% of funds)

2007

- $479,118—NSF grant (subcontract for isotopic analyses, Mitchell PI, and two others) Robust estimation of biodiversity dynamics: global *vs.* regional patterns in the end Ordovician mass extinction of graptolites (13% of funds)
- $299,360—Canadian Foundation for Climate and Atmospheric Sciences (Patterson PI with Holmden and Eglington) High-resolution Holocene climate derived from lacustrine sediment: stable isotope evidence from organic and inorganic proxy material (100% of funds).
- $200,000—NSERC Discovery Grant (Holmden PI) Multi-isotope investigation of Paleozoic climate and environment: a new approach using redox sensitive stable isotope tracers. (100% of funds)
- $3,536—USTEP (Patterson PI with Holmden) Summer research grant for M. Gagnon
- $3,536—USTEP (Holmden PI with Holmden) Summer research grant for K. Tauh
- $5600— NSERC USRA (Holmden PI with Patterson) Summer research support for J. Goulet

2006

- $91,035—NSF Grant 0617585 (subcontract for isotopic analyses, Andrew Jacobson, PI, Northwestern) The rates and mechanisms of Ca isotope transport in aquifers (20% of funds)
- $3400— USTEP (Holmden PI with Patterson) Summer research grant for V. Chostner

2005

- $1000—U of S (VP Research) proposal development (Holmden PI) (100% of funds)
- $20,000—U of S (VP Research) proposal development (Holmden PI) (100% of funds)

2003

- $138,000—NSERC Discovery Grant (Holmden PI) Nd isotope stratigraphy of epeiric sea carbonates (100% of funds)
- $24,447—NSERC Equipment Grant (Patterson PI with Holmden) U-series spikes (100% of funds)
- $14,900—Saskatchewan Industry and Resources (Holmden PI) Chemostratigraphy of Devonian limestones (100% of funds)
- $16,100—Saskatchewan Industry and Resources (Holmden PI) Ca isotope spikes (100% of funds)

2002

- $15,000—Potash Corporation of Saskatchewan (Rostron PI with Holmden) Brine Sampling Program (100% of funds)
- $15,000—NSERC Major Facilities Access Grant (Ansdell PI with 4 others) (100% of funds)

2001

- $21,315—NSERC equipment grant (Holmden PI) Microbalance (100% of funds)
- $20,000—Petro-Can Young Innovators Award (Holmden PI) Trace Metal isotopes in petroleum (100% of funds)
- $2,529,465—Canadian Foundation for Innovation (Holmden PI with 5 others) New Generation Mass Spectrometers
- CFI: $1,011,786; Province: $1,011,786; Industry: $329,750; University: $176,143
- $250,000—Strategic Initiatives Fund (Holmden PI with Rostron) Saskatchewan's Subsurface Brine Resource (100% of funds)
- $15,000—Potash Corporation (Holmden PI with Rostron) Saskatchewan brine sampling program (100% of funds)
- $30,000—PWGS contract - GSC Calgary (Holmden PI) Trace metals in Petroleum (100% of funds)

1999

- $15,000—Potash Corporation of Saskatchewan, Brine research (Holmden PI) (100% of funds)
- $109,496—NSERC Individual Research Grant (Holmden PI) (100% of funds)
- $120,000—NSERC Major Facilities Access Grant (Holmden PI with Ansdell) (20% of funds)
- $299,873—NSERC Major Equipment Grant (Kerrich PI with 5 others) Quadrupole ICP-MS
- $34,759—NSERC Equipment Grant (Kerrich PI with 5 others) Microwave digestion system

1998

- $994,000—Canada Foundation for Innovation (Holmen PI with 5 others) Trace Metal Clean Analytical Laboratory
- $276,650—Province of Saskatchewan Strategic Initiatives Fund (Holmden PI) Origin of Na_2SO_4 (50% of funds)
- $10,000—Potash Corporation of Saskatchewan (Holmden PI) Saskatchewan Brine Sampling Project (100% of funds)

1996

- $94,800—NSERC Individual Research Grant (Holmden PI) (100% of funds)
- $87,305—NSERC Equipment Grant (Holmden PI) Negative ion mass spectrometry upgrade (100% of funds)
- $5,000—NSERC President's Fund (Holmden PI) (100% of funds)

Service

University

1. Co-Director, Saskatchewan Isotope Laboratory (2002–present)
2. Curriculum Committee Chair, Dept. of Geological Sciences, (2004–present)

3. Public Relations Committee Chair, Dept. of Geological Sciences (2002–2003)
4. Student Academic Affairs Committee, College of Arts and Sciences (2001–2002)
5. Geochemistry Management Committee, Dept. of Geological Sciences (1996-1999)
6. Visiting Speakers Organizer, Dept. of Geological Sciences (1996–1998)

Professional

1. Reviewer for NSERC, NSF grants, and numerous journals.
2. Organized special sessions at International meetings of the Geological Society of America, the Geological Association of Canada, and a special symposium at the GSA sponsored Earth Systems II conference in Calgary in 2005.
3. Organizing committee for Geological Association of Canada's Annual General Conference held in Saskatoon in 2002.
4. Founding member of the Isotope Science Division of the Geological Association of Canada in 2003.
5. Consultant to the Potash Corporation of Saskatchewan for interpretation of H and O isotope data on waters leaking into salt mines. Developed rapid, automated methods for isotopic analysis of these waters.
6. H and O isotope fingerprinting of oil-field brines for petroleum industry in Saskatchewan, Alberta, Montana, and North Dakota with Dr. Ben Rostron (U of Alberta). Led to spin off company (Isobrine) headed by Rostron. The isotopic fingerprinting technique is also used by another company, G-Chem.