

# Dr. John Gosse

Professor, Department of Earth and Environmental Sciences, Dalhousie University

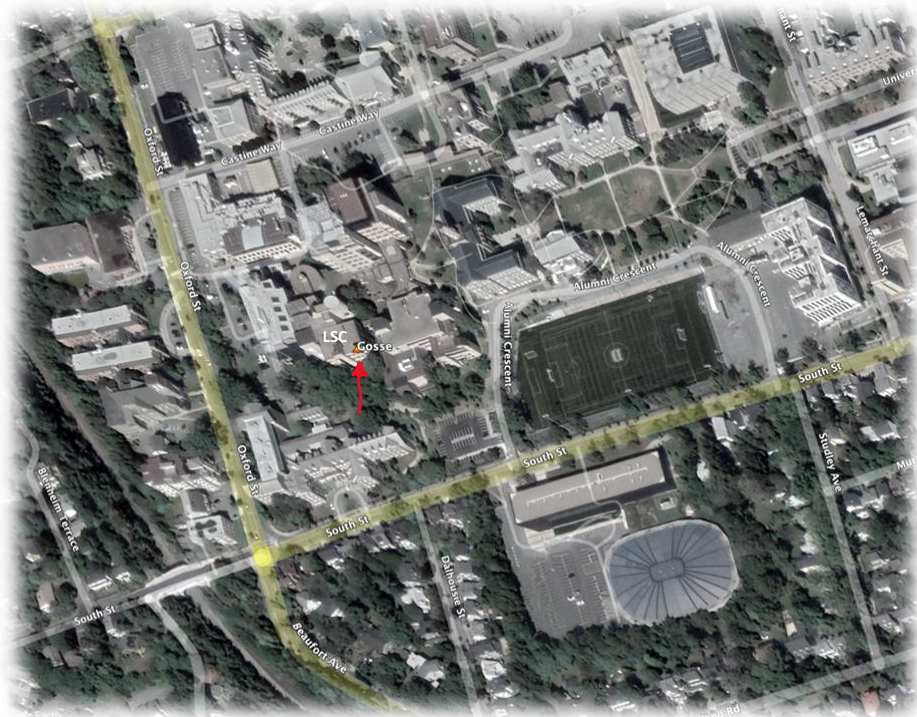
## 1 Contact Information

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## 2 CRISDal Lab Information

### **CRISDal Laboratory:**

“Cosmic Ray Isotopes Sciences at Dalhousie”

Rare isotopes are produced by cosmic ray particles (protons, neutrons, muons, and others) which interact with the nuclei of atoms in the atmosphere, soil or rock.

In our seven labs we chemically or thermally extract these rare isotopes from different materials (e.g. lake sediment, lavas, permafrost ice, boulders, mountains, stream sediments, soils, cliff walls left after a landslide, fault scarps, sediments surrounding fossils). Then we prepare them for analysis of the isotope of interest, and check purities and measure geochemical constituents of the sample material using ICP-OES.

We prepare targets of cosmogenic nuclides  $^{10}\text{Be}$  (half life 1.4 Myr),  $^{14}\text{C}$  (1500 yr),  $^{26}\text{Al}$  (0.7 Myr), and  $^{36}\text{Cl}$  (0.3 Myr) for measurement by accelerator mass spectrometry (AMS). We have worked with CAMS-Lawrence Livermore National Lab in California, PRIME Lab at Purdue University in Indiana, ETH-Zurich Switzerland, and recently at the new A.E. Lalonde AMS facility at the University of Ottawa.

We are Canada’s only lab for producing cosmogenic isotope targets, and one of only 9 labs worldwide to prepare and interpret measurements on all four commonly used cosmogenic radionuclides.

By nature our research is highly collaborative. We provide ages or rates of geological events and processes, such as ancient earthquakes, ages of fossils or eDNA, ages of landslides, timing of deglaciation, ages of lavas, stream terraces, erosion rates of landforms or entire catchments.

See selected publications below.

### Current CRISDal Lab People:

**John Gosse**, Director

**Guang Yang**, Chief Lab Manager (since 2002), <sup>10</sup>Be, <sup>26</sup>Al, <sup>36</sup>Cl chemistry

**Alexis Imperial**, Lab Manager for the ICP-OES and Mineral Purification Labs (since 2022)

**Gerald Raab** (Post Doc since 2021, using isotopes produced by cosmic muons to measure long term erosion rates of the Swiss Alps over the past 10 million years, using a technique called Muon Paleotopometry, which was developed in collaboration with Dr. A. Hidy at LLNL.

**Cody Paige** (PhD candidate since 2017, helped design, and then built and helped write the code to automate the 4<sup>th</sup> generation <sup>14</sup>C extraction lab)

**Maureen Matthew** (PhD candidate since 2021, focused on rock avalanche in coastal Eastern Canada, using <sup>36</sup>Cl to date acceleration of unstable cliffs)

**Lauren MacLellan** (PhD student since 2022, using the new <sup>14</sup>C extraction line and studying the production of isotopes by muons at deep depths)

We hire 5 – 10 undergraduate research assistants each year from Dalhousie or neighbouring universities in Nova Scotia.

We are currently training visiting researchers, students, and colleagues from Canada, US, Germany.

*If you are interested in joining the CRISDal Lab team, please let us know*

## 3 [About John](#)

John is a geomorphologist (studies the evolution of landscapes on Earth) and geochronologist (dates geological events and determines rates of geological processes). Much of his career research interests and collaborative projects revolve around natural hazards and the effects of (paleo)climate change and active tectonics. Originally from Newfoundland, and married to Annette who he met at MUN, they have three children and a dog. Annette and John are excited about moving into the woods near Musquodoboit Harbour in 2023. John completed his BSc(Hon) at MUN in St. John's NL, his PhD at Lehigh U. in Bethlehem PA (supervisors Ed Evenson and Jeff Klein at UPenn), and post-doc at Los Alamos National Lab (sponsor C. Harrington). He taught at U. Kansas, *Rock Chalk Jayhawks*, for four years before returning to Atlantic Canada in 2001 to work at Dalhousie. Current field areas are the Canadian Arctic and Newfoundland, and exciting places with colleagues.



### *John currently teaches:*

- **ERTH-1060** a first-year course called *Earthquakes, Volcanoes, and other Natural Hazards*
- **ERTH/GEOG-3302** *Quaternary Sedimentary Environments*, which explores the effect of climate and tectonics on the deposition of sediments in mountains, streams, lakes, the ocean, and under glaciers.
- **ERTH 4002** *Senior Geology Field School* (with Mike Young who is the field school director) in parts of Utah, Nevada, and California for a month each year around April and May.
- Graduate courses, including **ERTH6400**, a co-taught course on *Geochronology and Thermochronology*, currently led by Isabelle Coutand with others.
- Short courses on *applications and theory of cosmic ray isotopes*

### *John's principal research interests in the past decade can be sampled with these publications:*

- **Pliocene-Pleistocene climate transition and landscape, paleontology, paleoecology, and PoLAR-FIT**
  - Kjaer, K. and 33 more including Gosse, J.C. (2022). A 2-Million-year-old ecosystem in Greenland uncovered by Environmental DNA. *Nature*. Dec 8;612(7939):283-91. [Link](#)
  - Davies, N.S., Gosse, J.C., Rouillard, A., Rybczynski, N., Meng, J., Reyes, A.V. and Kiguktak, J. (2022). Wood jams or beaver dams? Pliocene life, sediment and landscape interactions in the Canadian High Arctic. *Palaios*. 37(6): 330-347. [Link](#)
  - Fletcher, T. Eble, C. Sinninghe Dampte, J.S. Brown, K.J. Rybczynski, N. Gosse, J. Liu, L. Ballantyne, A. (2021). Widespread wildfire across the Pliocene Canadian Arctic Archipelago. *Palaogeography, Palaeoclimatology, Palaeoecology*. 584: 110653 [Link](#)
  - Fletcher, T.L., Warden, L., Damsté, J.S.S., Brown, K.J., Rybczynski, N., Gosse, J.C. and Ballantyne, A.P. (2019). Evidence for fire in the Pliocene Arctic in response to amplified temperature. *Climate of the Past*, 15(3), pp.1063-1081. [Link](#)
  - Gosse, J. C., Ballantyne, A. P., Barker, J. D., Csank, A. Z., Fletcher, T. L., Grant, G. W., Greenwood, D. R., MacPhee, R. D., & Rybczynski, N. (2017). PoLAR-FIT: Pliocene Landscapes and Arctic Remains—Frozen in Time. *Geoscience Canada*, 44(1), 47–54. <https://doi.org/10.12789/geocanj.2017.44.116> [Link](#)
  - Davies, N. S., Gosse, J. C., & Rybczynski, N. (2014). Cross-Bedded Woody Debris From A Pliocene Forested River System In the High Arctic: Beaufort Formation, Meighen Island, Canada. *Journal of Sedimentary Research*, 84(1), 19-25. [Link](#)
  - Rybczynski, N., Gosse, J. C., Harrington, C. R., Wogelius, R. A., [Hidy, A. J.](#) and Buckley, M. (2013) Mid-Pliocene warm-period deposits in the High Arctic yield insight into camel evolution. *Nature Communications*. 4. 1550. [Link](#)

## • Active tectonics and seismic hazards

- Özpolat, E., Yıldırım, C., Görüm, T., Gosse, J.C., Şahiner, E., Sarıkaya, M.A. and Owen, L.A., 2022. Three-dimensional control of alluvial fans by rock uplift in an extensional regime: Aydın Range, Aegean extensional province. *Nature Scientific reports*, 12(1), pp.1-14. [Link](#)
- Zhang, M. Liu, M. Ploudre, A. Bao, F. Wang, R. Gosse, J. (2021). Source characterization for two small earthquakes in Dartmouth, Nova Scotia, Canada: Pushing the limit of single station. *Seismological Research Letters*. 92(4): 2540-2550. [Link](#)
- Shi, X., Furlong, K.P., Kirby, E., Meng, K., Marrero, S., Gosse, J., Wang, E. and Phillips, F., (2017). Evaluating the size and extent of paleo-lakes in central Tibet during the Late Pleistocene. *Geophysical Research Letters* 44, 5476–5485 [Link](#)
- Smith, S.G., Wegmann, K.W., Ancuta, L.D., Gosse, J.C. and Hopkins, C.E. (2016). Paleotopography and erosion rates in the central Hangay Dome, Mongolia: Landscape evolution since the mid-Miocene. *Journal of Asian Earth Sciences*, 125, pp.37-57. [Link](#)
- Higgins, M., Schoenbohm, L. M., Brocard, G., Kaymakci, N., Gosse, J. C., & Cosca, M. A. (2015). New kinematic and geochronologic evidence for the Quaternary evolution of the Central Anatolian fault zone (CAFZ). *Tectonics*, 34(10), 2118-2141. [Link](#)
- Silver, C.R.P., Murphy, M., Taylor, M.H., Gosse, J., Baltz, T. (2015) Neotectonics of the Western Nepal Fault System: Implications for Himalayan strain-partitioning. *Tectonics* 34, 2494-2513 [Link](#).
- Veloza, G., Taylor, M., Mora, A., & Gosse, J. (2015). Active mountain building along the eastern Colombian Subandes: A folding history from deformed terraces across the Tame anticline, Llanos Basin. *Geological Society of America Bulletin*, B31168-1. [Link](#)
- Rittase, W. M., Kirby, E., McDonald, E., Walker, J. D., Gosse, J., Spencer, J. Q., & Herrs, A. J. (2014). Temporal variations in Holocene slip rate along the central Garlock fault, Pilot Knob Valley, California. *Lithosphere*, 6(1), 48-58. [Link](#)
- Murphy, M. A., Taylor, M. H., Gosse, J., Silver, C. R. P., Whipp, D. M., & Beaumont, C. (2014). Limit of strain partitioning in the Himalaya marked by large earthquakes in western Nepal. *Nature Geoscience*, 7(1), 38-42 [Link](#)
- Gold, R. D., dePolo, C., Briggs, R., Crone, A. and Gosse, J. C. (2013) Late Quaternary slip-rate variations along the Warm Springs Valley fault system, northern Walker Lane, California-Nevada border. *Bulletin Seismological Society of America*. 103 (1), 542-558 [Link](#)

## • Landslide hazards

- Hilger, P. Hermanns, R.L. Czekirda, J. Myhra, K.S. Gosse, J.C. Eitzelmüller, B. (2021). Permafrost as a first order control on long-term rock-slope deformation in (sub-) Arctic Norway. *Quaternary Science Reviews*. 251: 106718.
- Gosse, J.C., Tremblay, T., Broom, L.A., Campbell, D.C., Wenzel, G., Nedimovic, M.R. and Forget Brisson, L. (2020): Initial results from the ULINNIQ seismicity and tsunami hazard project, northeastern Baffin Island, Nunavut; in *Summary of Activities 2019, Canada-Nunavut Geoscience Office*, p. 101-124 [Link](#)
- Spooner, I., Dunnington, D., Gosse, J., Osborn, G., Berger, A.R. and Brookes, I., (2020). Large-Scale Rock Slope Deformation from the Tablelands and Lookout Hills of Western Newfoundland, Canada. In *Landscapes and Landforms of Eastern Canada* (pp. 369-380). Springer, Cham. [Link](#)
- Böhme, M., Hermanns, R.L., Gosse, J., Hilger, P., Eiken, T., Lauknes, T.R. and Dehls, J.F., (2019). Comparison of monitoring data with paleo-slip rates: Cosmogenic nuclide dating detects acceleration of a rockslide. *Geology*, 47(4), pp.339-342. [Link](#)
- Hilger, P., Gosse, J.C., Hermanns, R.L. (2019), How significant is inheritance when dating rockslide boulders with terrestrial cosmogenic nuclide dating? - A case study of an historic event. *Landslides*. LASL-D-18-00430, p. 1-10 [Link](#)
- Hilger, P., Hermanns, R.L., Gosse, J.C., Jacobs, B., Eitzelmüller, B. and Krautblatter, M. (2018). Multiple rock-slope failures from Mannen in Romsdal Valley, western Norway, revealed from Quaternary geological mapping and 10Be exposure dating. *The Holocene*, p.0959683618798165 [Link](#)
- Broom, L.M., Campbell, D.C. and Gosse, J.C., (2017). Investigation of a Holocene marine sedimentary record from Pond Inlet, northern Baffin Island, Nunavut; in *Summary of Activities 2017, Canada-Nunavut Geoscience Office*, p. 93–104. [Link](#)
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- Schleier, M., Hermanns, R.L., Rohn, J. Gosse, J.C. (2015). Diagnostic characteristics and paleodynamics of supraglacial rock avalanches, Innerdalen, Western Norway. *Geomorphology*. 245, 23-39. [Link](#)
- Sturzenegger, M., Stead, D., Gosse, J., Ward, B., & Froese, C. (2014). Reconstruction of the history of the Palliser Rockslide based on <sup>36</sup>Cl terrestrial cosmogenic nuclide dating and debris volume estimations. *Landslides*, 1-10. [Link](#)
- Hewitt, K., Gosse, J. and Clague, J. J. (2011) Rock avalanches and the pace of late Quaternary development of river valleys in the Karakoram Himalaya. *GSA Bulletin*. 123 (9-10) 1836-1850. [Link](#)
- Antinao, J.-L., Gosse, J. (2009). Large rockslides in the Southern Central Andes of Chile (32-34.5° S): Tectonic control and significance for post-Miocene landscape evolution. *Geomorphology*. 144: 117-133 [Link](#)

- **Erosion**

- Norris, S.L., Gosse, J.C., Millan, R., Mouginit, J., Rabatel, A., Morlighem, M., Bolton, MSM, Alley, R. (in revision from initial submission) Global contemporary glacial erosion: reconsidering its drivers. *Nature Geosciences*.
- Lehmann, N., Stacke, T., Lehmann, S., Lantuit, H., Gosse, J., Mears, C., Hartmann, J., Thomas, H. (accepted) Alkalinity responses to climate warming destabilise the Earth's thermostat. *Nature Communications*. NCOMMS-22-22577C.

- **Paleoclimate, glaciation, alluvial fans**

- Stoker, B.J., Margold, M., Gosse, J.C., Hidy, A.J., Monteath, A.J., Young, J.M., Gandy, N., Gregoire, L.J., Norris, S.L. and Froese, D., (2022). The collapse of the Cordilleran–Laurentide ice saddle and early opening of the Mackenzie Valley, Northwest Territories, Canada, constrained by <sup>10</sup>Be exposure dating. *The Cryosphere*, 16(12), pp.4865-4886. [Link](#)
- Evans, D.J.A. Smith, I.R. Gosse, J.C. Galloway, J.M. (2021). Glacial landforms and sediments (landsystem) of the Smoking Hills area, Northwest Territories, Canada: Implications for regional Pliocene-Pleistocene Laurentide Ice Sheet dynamics. *Quaternary Science Reviews*. 262(106958) [Link](#)
- Norris, S.L. Tarasov, L. Monteath, A.J. Gosse, J.C. Hidy, A. Margold, M. Froese, D. (2021). Rapid retreat of the southwestern Laurentide Ice Sheet driven by Bølling-Allerød warming. *Geology*. 50 (4) 417-421. [Link](#)
- Margold, M., Gosse, J.C., Hidy, A.J., Woywitka, R.J., Young, J.M. and Froese, D., (2019). Beryllium-10 dating of the Foothills Erratics Train in Alberta, Canada, indicates detachment of the Laurentide Ice Sheet from the Rocky Mountains at~15 ka. *Quaternary Research*, 92(2), pp.469-482. [Link](#)
- Margreth, A., Gosse, J.C. Dyke, A.S.(2017). Wisconsinan and early Holocene glacial dynamics of Cumberland Peninsula, Baffin Island, Arctic Canada. *Quaternary Science Reviews*. 168: 79-100. [Link](#)
- Nounos, B. Goehring, B.M. Osborn, G. Margold, M. Ward, B. Bond, J. Clarke, G.K.C. Clague, J.J. Lakanan, T. Koch, J. Caffee, M.W. Gosse, J. Stroeve, A.P. Seguinot, J. Heyman, J.(2017). Cordilleran ice sheet mass loss preceded climate reversals near the Pleistocene Termination. *Science*. 358 (6364), 781-784. [Link](#)
- Antinao, J.L.\*, McDonald, E., Rhodes, E.J., Brown, N., Barrera, W., Gosse, J.C., Zimmermann, S. (2016). Late Pleistocene-Holocene alluvial stratigraphy of southern Baja California, Mexico, *Quaternary Science Reviews*, Volume 146, 15 August 2016, Pages 161-181, ISSN 0277-3791 [Link](#)
- Utting, D.J., Gosse, J.C., Kelley, S.E., Vickers, K.J., Ward, B.C. and Trommelen, M.S., (2016). Advance, deglacial and sea-level chronology for Foxe Peninsula, Baffin Island, Nunavut. *Boreas*, 45(3), pp.439-454. [Link](#)
- Margreth, A., Gosse, J.C., Dyke, A. (2016) Quantification of subaerial and subglacial erosion rates on high latitude upland plateaus: Cumberland Peninsula, Baffin Island, Canada. *Quaternary Science Reviews* 133, 108-129 [Link](#)
- Margreth, A., Dyke, A.S., Gosse, J.C., Telka, A.M. (2014) Neoglacial ice expansion and Late Holocene cold-based ice cap dynamics on Cumberland Peninsula, Baffin Island, Arctic Canada, *Quaternary Science Reviews*. 91, 242-256. [Link](#)
- Hidy, A. J., Gosse, J. C., Blum, M. D., & Gibling, M. R. (2014). Glacial–interglacial variation in denudation rates from interior Texas, USA, established with cosmogenic nuclides. *Earth and Planetary Science Letters*, 390, 209-221. [Link](#)
- Hidy, A. J., Gosse, J. C., Froese, D. G., Bond, J. D., Rood, D. (2013) A Latest Pliocene age for the earliest and most extensive Cordilleran Ice Sheet in northwestern Canada. *Quat Sci Rev* 61, 77-84. [Link](#)

- **TCN Technique Development and Testing**

- Marrero, S.M., Phillips, F.M., Caffee, M. and Gosse, J., (2020). Corrigendum to “CRONUS-Earth cosmogenic <sup>36</sup>Cl calibration”[Quat. Geochronol. 31 (2016) 199–219]. *Quaternary Geochronology*, 61, p.101130. [Link](#)
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