Paul A Selvadurai, Ph.D.

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Google Scholar h-index: 15

Research Interests

Progressive rock damage –Dynamic failure – Earthquake and fault mechanics – Induced seismicity

Education

University of California, Berkeley, Berkeley, USA
- Ph.D., Civil and Environmental Engineering, December 2015
- Thesis: "Laboratory Studies of Frictional Sliding and the Implications of Precursory Seismicity"
- Principle Advisor: Professor Steven D. Glaser
- Advisors: Professor D. Dreger, Professor A. Bayen
- Viva Voce date: December 18th, 2015.

McGill University, Montréal, Canada
- M.Eng., Civil Engineering and Applied Mathematics, September 2010
- Thesis: "Permeability of Indiana Limestone: Experiments and Theoretical Concepts for Interpretation of Results"
- Principle Advisor: Professor Yixin Shao.

McGill University, Montréal, Canada
- B.Sc., Mechanical Engineering, September 2007.

Experience

Senior Researcher ETH Zürich, Switzerland Laboratory Seismology Group Leader	2020-*Present*
Postdoctoral Researcher ETH Zürich, Switzerland	2017-2020
Research Specialist University of California, Berkeley, USA	2016
Acoustic Emission (AE) Consultant National Research Institute for Earth Science and Disaster Prevention, Tsukuba, JPN	2015
Research Assistant Lawrence Berkeley National Laboratory, Berkeley, USA	2011
Consultant Nuclear Waste Management Organization of Ontario, Toronto, CAN	Jan. 2011
Laboratory Research Assistant McGill University, Montréal, CAN	2006-2010

Awards

Presentation Award Conference of Green and Low-Carbon Development of Coal Industry hosted by Chinese Academy of Engineering (CAE).	2023
Best Presentation Award The 3rd International Conference on Coupled Processes in Fractured Geological Media: Observation, Modeling, and Application	2022
John Carter Award International Association for Computer Methods and Advances in Geomechanics	2017

Outstanding Student Paper Award in Seismology American Geophysical Union 2013

Award for Excellent Paper International Association for Computer Methods and Advances in Geomechanics 2011

Lady Jane Lewis Fellowship University of California, Berkeley 2010

Grants

Swiss National Science Foundation (200021_204429) Towards a physical understanding of critical phenomena in the pre-failure damage of rock – Improvements in forecasting natural and induced earthquakes (PI) 2022

Swiss National Science Foundation (200021_192017) Advancing laboratory seismology for improving the forecasting of natural and induced earthquakes (co-PI) 2020

NSERC Postgraduate Scholarships-Doctoral (PGSD3-391943-2010) 2010

Current Advising

Primary supervisor: H. Chen (PhD 2yr), S. Michail (PhD 4yr)
Co-supervisor: M. Rast (PhD, 2yr), M. Castelleano (PhD, 4yr), A. Salazar (PhD 4yr)

Students Supervised

Bianchi, P. (Doctoral dissertation: "Integrating Physics-Based Numerical Models and Novel Experimental Approaches to Investigate Earthquake Preparatory Processes") 2024

Wu, R. (Doctoral dissertation: "Laboratory acousto-mechanical studies into moisture-induced changes of elastic properties in fine-grained granite") 2022

Niu, Z. (Master's Dissertation: "Experimental study on the seismic and aseismic deformation during the failure of granitic rock") 2021

Teaching

Lecturer (651-4025-00L) Rock Mechanics and Rock Engineering 2022-present
ETH Zürich (Graduate-level)

Lecturer (651-4103-00L) Earthquakes II: Source physics 2018-present
ETH Zürich (Graduate-level)

Teaching Assistant (CE 271): Sensors and Signal Interpretation 2013-2016
University of California, Berkeley (Graduate-level)

Teaching Assistant (CIVE 207): Solid Mechanics 2009
McGill University (Undergraduate-level)

Publications in Peer-Reviewed Scientific Journals

Shi, P., Meier, M.-A., Villiger, L., Tuinstra, K., **Selvadurai, P.A.**, Lanza, F., Yuan, S., Obermann, A., Mesimeri, M., Münchmeyer, J., Bianchi, P., Wiemer, S. (2024) From labquakes to megathrusts: Scaling deep learning based pickers over 15 orders of magnitude. *JGR: Machine Learning and Computation* (*recently accepted*)

Bianchi, P., **Selvadurai, P.A.**, Dal Zilio, L. et al. (2024) Pre-Failure Strain Localization in Siliclastic Rocks: A Comparative Study of Laboratory and Numerical Approaches. Rock Mech Rock Eng 57, 5371–5395. https://doi.org/10.1007/s00603-024-04025-y

Kammer, D.S., McLaskey, G.C., Abercrombie, R.E., Ampuero, J-P., Cattania, C., Cocco, M., Dal Zilio, L. Dresen, G., Gabriel, A.-A., Ke, C.-Y, Marone, C., **Selvadurai, P.A**., Tinti, E. (2024) Earthquake energy dissipation in a fracture mechanics framework. Nat Commun 15, 4736 (2024). https://doi.org/10.1038/s41467-024-47970-6

Rast, M., Madonna, C., **Selvadurai, P.A**., Wenning, Q., Ruh, J.B. (2024) Triaxial friction tests on fault slip in clay-rich rocks due to water-clay interactions. Journal of Geophysical Research: Solid Earth, Journal of Geophysical Research: Solid Earth, 129, e2023JB028235. https://doi.org/10.1029/2023JB028235

Wu, R., **Selvadurai, P. A**., Li, Y., Leith, K., Lei, Q., & Loew, S. (2023). Laboratory acousto-mechanical study into moisture-induced reduction of fracture stiffness in granite. Geophysical Research Letters, 50, e2023GL105725. https://doi.org/10.1029/2023GL105725

Wu, R., **Selvadurai, P.A.,** Li, Y., Leith, K., Loew, S. (2023) "Laboratory acousto-mechanical study into moisture-induced changes of elastic properties in intact granite" International Journal of Rock Mechanics and Mining Sciences. 170, 105511

Selvadurai, P.A., Galvez, P., Mai, P.M., Glaser, S.D. (2023) "Modeling frictional precursory phenomena using a wear-based rate- and state-dependent friction model in the laboratory" *Tectonophysics*, 847, 229689, https://doi.org/10.1016/j.tecto.2022.229689

Köpfli, M., Gräff, D., Lipovsky, B. P., **Selvadurai, P. A.**, Farinotti, D., & Walter, F. (2022) "Hydraulic conditions for stick-slip tremor beneath an alpine glacier" *Geophysical Research Letters*, 49, e2022GL100286. https://doi.org/10.1029/2022GL100286

Selvadurai, P.A., Wu, R., Bianchi, P. et al. (2022) "A Methodology for Reconstructing Source Properties of a Conical Piezoelectric Actuator Using Array-Based Methods." *Journal of Nondestructive Evaluation* 41, 23. https://doi.org/10.1007/s10921-022-00853-6

Gräff, D., Köpfli, M., Lipovsky, B. P., **Selvadurai, P. A.**, Farinotti, D., & Walter, F. (2021). Fine structure of microseismic glacial stickslip. *Geophysical Research Letters*, 48, e2021GL096043. https://doi.org/10.1029/2021GL096043

Wu, R., **Selvadurai, P.A.**, Chen, C. et al. (2021) "Revisiting Piezoelectric Sensor Calibration Methods Using Elastodynamic Body Waves." *Journal of Nondestructive Evaluation* 40, 68. https://doi.org/10.1007/s10921-021-00799-1

Passarelli, L. **Selvadurai, P.A.**, Rivalta, E. and Sigurjón, J. (2021) "The source scaling and seismic productivity of slow slip transients", *Science Advances*, 7(32) DOI: 10.1126/sciadv.abg9718

Villiger, L., Gischig, V.S., Doetsch, J., Krietsch, H., Dutler, N., Jalali, M., Valley, B., **Selvadurai, P.A.**, Mignan, A., Plenkers, K., Giardini, D., Amann, F. and Wiemer, S. (2020), "Influence of reservoir geology on seismic response during decameter scale hydraulic stimulations in crystalline rock", Solid Earth, 11, 627–655, https://doi.org/10.5194/se-11-627-2020, 2020.

Selvadurai, A.P.S., Blain-Coallier, A. and **Selvadurai, P.A.** (2020) "Estimates for the Effective Permeability of Intact Granite Obtained from the Eastern and Western Flanks of the Canadian Shield" *Minerals* 10, no. 8: 667. https://doi.org/10.3390/min10080667

Selvadurai, P.A. (2019), "Laboratory insight into seismic estimates of energy partitioning during dynamic rupture: An observable scaling breakdown", *Journal of Geophysical Research: Solid Earth*, 124 doi.org/10.1029/2018JB017194.

Selvadurai, A.P.S., **Selvadurai, P.A.** and Nejati, M. (2019), "NA Multi-phasic Approach for Estimating the Biot Coefficient for Grimsel Granite", accepted in *Solid Earth*, https://doi.org/10.5194/se-2019-82.

Selvadurai, A.P.S., **Selvadurai, P.A.** and Suvorov, A. (2018), "Contact mechanics of a dilatant region located at a compressed elastic interface", *International Journal of Engineering Science,* 133, pp. 144-168.

Selvadurai, P.A., Parker, J.M. and Glaser, S.D. (2017a), "Numerical Modeling Describing the Effects of Heterogeneous Distributions of Asperities on the Quasi-static Evolution of Frictional Slip", *Rock Mechanics and Rock Engineering*, https://doi.org/10.1007/s00603-017-1333-9.

Selvadurai, P.A., Parker, J.M. and Glaser, S.D. (2017), "On factors controlling precursor slip fronts in the laboratory and their relation to slow slip events in nature", *Geophysical Research Letters*, 44, doi:10.1002/2017GL072538.

Saltiel, S., **Selvadurai, P.A.,** Bonner, B.P., Glaser, S.D. and Ajo-Franklin, J.B. (2017), "Experimental development of low-frequency shear modulus and attenuation measurements in mated rock fractures: Shear mechanics due to asperity contact area changes with normal stress", *Geophysics*, 82(2) P. M19–M36, 10.1190/GEO2016-0199.1. [Awarded the Honorable Mention Best Paper Prize].

Selvadurai, P.A. and Glaser, S.D. (2017), "Asperity generation and its relationship to seismicity on a planar fault: a laboratory simulation", *Geophysical Journal International*, DOI: 10.1093/gji/ggw439.

Selvadurai, P.A. and Glaser, S.D. (2015a), "Characteristics of asperity breakdown along a failing frictional interface using optical-acoustic techniques", *Sensors*, 15, 9791-9814.

Selvadurai, P.A. and Glaser, S.D. (2015), "Laboratory-developed contact models controlling instability on frictional faults", *Journal of Geophysical Research: Solid Earth,* 120.

Selvadurai, A.P.S., Suvorov, A.P. and **Selvadurai, P.A.** (2015), "Thermo-hydro-mechanical processes in fractured rock formations during glacial advance", *Geoscientific Model Development*, 7, 7351-7394.

Selvadurai, P.A. and Selvadurai, A.P.S. (2014), "On the effective permeability of a heterogeneous porous medium: the role of the geometric mean", *Philosophical Magazine*, 94, 2318-2338.

Selvadurai, A.P.S. and **Selvadurai, P.A.** (2011), "Historical Notes: A Momentary Lapse in Concentration by the Genius?", *Mathematics Today*, 47, 244-245.

Selvadurai, A.P.S. and **Selvadurai, P.A.** (2010), "Surface permeability tests: Experiments and modeling for estimating effective permeability", *Proceedings of the Royal Society A*, 466(2122), 2819–2846 [Awarded the IACMAG 2011 Best Paper Prize].

Selvadurai, P.A. and Selvadurai, A.P.S. (2007), "On cavity flow permeability testing of a Sandstone," *Groundwater*, 45(1) 93-97.

Under review/In preparation for peer-reviewed journal

Salazar Vásquez, A.F., **Selvadurai, P.A**., Bianchi P., Rabaiotti, C., Germanovich, L.N., Madonna, C., Wiemer, S. (Under review in *Nature Scientific Reports*) Aseismic strain localization prior to failure and associated seismicity in crystalline rock.

Bianchi, P., **Selvadurai, P.A,** Dal Zilio, L., Gerya, T., Madonna, C., Weimer, S., (Under review in *Seismica*) Effects of Energy Dissipation on Precursory Seismicity During Earthquake Preparation.

Chen, H., **Selvadurai, P.A**., de Geus, T., Salazar Vasquez, A., Bianchi, P., Michail, S., Rast., M. Madonna, C., Wiemer, S. (under review *Geophysical Research Letters*) Investigating Criticality in Brittle Failure of Siliciclastic Rocks Using Fiber-Optic Strain Sensing.

Li, Y., Leith, K., Wu. R., **Selvadurai, P.A.**, Parras, M., Loew, S. (under review to *Rock Mechanics and Rock Engineering*) Deformation of macroscopic fractures as a result of wetting.

Michail, S., **Selvadurai, P.A.**, Rast, M. Salazar Vásquez, A.F., Bianchi, P., Madonna, C., Wiemer, S. (Under Review in *Earth and Planetary Science Letters*) Laboratory Insight into the Evolution of the Seismic Potential of an Asperity due to Wear.

Bianchi, P., **Selvadurai, P. A.**, Salazar Vásquez, A., Madonna, C., & Wiemer, S. (in preparation fro Geophysical Research Letters) The Effects of Fluid Pre-Conditioning on the Deformation Response of a Laboratory Fault.

Peer-reviewed Conference Papers

Bianchi, P., **Selvadurai, P.A.,** Salazar, A., Dal Zilio, L., Gerya, T., Madonna, C., Wiemer, S. (2022) "A Study of Progressive Failure in Porous Rocks Using Numerical and Experimental Modeling" Paper presented at *the 56th U.S. Rock Mechanics/Geomechanics Symposium*, Santa Fe, NM, USA, June 2022. https://doi.org/10.56952/ARMA-2022-0621

Salazar V.A., **Selvadurai, P.A.**, Niu, Z., Bianchi, P., Rabaiotti, C., Madonna, C., Wiemer, S. and Germanovich, L.N. (2022) "Insights into triaxial testing using coupled acoustic emission and distributed optical fiber strain measurements" Paper presented at *the 56th U.S. Rock Mechanics/Geomechanics Symposium*, Santa Fe, NM, USA, June 2022. https://doi.org/10.56952/ARMA-2022-0706

Wu, R., **Selvadurai, P.A.**, Chen, C. J., and O. Moradian. (2020) "A FEM-Based Methodology to Acquire Broadband Empirical Green's Functions to Understand Characterization Tests of Acoustic Emission Sensors." Paper presented at *the 54th U.S. Rock Mechanics/Geomechanics Symposium*, physical event cancelled, June 2020.

Tsui, K., Seward, A., Siddiqi, G., Boyd, L., Feitz, A., Johannesson, G. Flovenz, O., Beardsmore, G., Pettitt, W., Orozco, G., Meier, P., **Selvadurai, P.A.**, Wiemer, S. and Podgorney, R. (2020), International partnership for geothermal technology (IPGT), *in Proceedings World Geothermal Congress 2020*, Reykjavik, Iceland.

Selvadurai, P.A., Parker, J.M. and Glaser, S.D. (2016), "Numerical modeling of heterogeneous asperity distributions controlling the growth of shear rupture on a frictional fault", *in 50th US Rock Mechanics | Geomechanics Symposium*, June 2016, Houston, TX, USA.

Selvadurai, P.A. and Glaser, S.D. (2014), "Insights into dynamic asperity failure in the laboratory", *in 48th US Rock Mechanics | Geomechanics Symposium*, June 2014, Minneapolis, MN, USA.

Selvadurai, P.A. and Glaser, S.D. (2013), "Experimental evidence of micromechanical processes that control localization of shear rupture nucleation", *in 47th US Rock Mechanics | Geomechanics Symposium*, June 2013, San Francisco, CA, USA.

Selvadurai, P.A. and Glaser, S.D. (2012), "Direct measurement of contact area and seismic stress along a sliding interface", *in 46th US Rock Mechanics | Geomechanics Symposium,* June 2012, Chicago, IL, USA.

Selvadurai, A.P.S. and **Selvadurai, P.A.** (2011), "Recent advances in modeling techniques for estimating permeability of anisotropic and inhomogeneous geomaterials", *in 13th International Conference of the International Association for Computer Methods and Advances in Geomechanics*, 221-230.

Selvadurai, A.P.S. and **Selvadurai, P.A.** (2010), "The role of modelling and simulations in estimating multiscale effective permeability", R. I. Borja, E. M. Dunham, E. Kuhl and J. A. White, eds, *in International Workshop on Multiscale and Multiphysics Processes in Geomechanics*, Stanford University, Palo Alto, CA, USA.

Invited Lectures or Contributions

Selvadurai, P.A. (2023), ***Invited Seminar***: "Seismicity alone may misrepresent damage in crystalline rocks: An improved failure assessment using distributed fiber optic measurements" NSERC/Energi Simulation Chair Seminar Series. University of Toronto.

Selvadurai, P.A. (2023), ***Invited Seminar***: "Revisiting Rock Deformation Using Distributed Strain Sensing Fiber Optic Technology" Research Seminar in Applied Mechanics. McGill University.

Selvadurai, P.A. (2023), ***Invited webinar*****:** "Unravelling complex deformation and localization of brittle failure in triaxial tests" Computational Infrastructure for Geodynamics. https://geodynamics.org/events/details/301

Selvadurai, P.A. (2023), ***Invited Seminar***: "Unravelling complex deformation and localization of brittle rock deformation in triaxial tests" Conference of Green and Low-Carbon Development of Coal Industry hosted by Chinese Academy of Engineering (CAE).

Selvadurai, P.A. (2019), ***Invited talk:*** "Seismologic estimates of energy flow during dynamic rupture: Benefits of laboratory settings to understand up-scaling processes", *American Geophysical Union (AGU) Fall Meeting*, San Francisco, CA.

Selvadurai, P.A. (2019) "Investigations into the variety of frictional behaviors produced between worn PMMA interfaces", ***Keynote lecture*** *in Geophysical Colloquium*, Kaust, Thulwal, Kingdom of Saudi Arabia.

Selvadurai, P.A. (2019) "Investigations into the variety of frictional behaviors produced between worn PMMA interfaces", ***Keynote speaker*** *in the Workshop on rock friction, non-linear physics and slow earthquakes*, Fukuoka, Japan.

Selvadurai, P.A., Glavez, P., Wiemer, S. and Mai, P. M. (2019), ***Invited talk:*** "Modelling precursory seismicity in the laboratory using a roughness derived RS friction model", *Japanese Geoscience Union Meeting 2019*, SCG48-33, Chiba, Japan.

Selvadurai P.A., Edward, B., Tormann, T., Wiemer, S. and Glaser, S.D. (2018), ***Invited talk:*** "Roughness-induced rupture barriers constraining the size of spontaneous seismicity on frictional interfaces in the laboratory", *American Geophysical Union (AGU) Fall Meeting*, Washington, DC.

Selvadurai, P.A. (2017) "Caprock Defects and their Influences on Secure Geologic Sequestration of CO2", ***invited talk presented on behalf of A.P.S. Selvadurai*** *in the 15th International Conference of the International Association for Computer Methods and Advances in Geomechanics*, Wuhan, China October 21, 2017.

Selvadurai, P.A. (2017) "A laboratory study in the characteristics of seismicity on worn faults", ***invited*** *ETH Geophysical Colloquium HS2017 Seminar Series*, ETH Zurich, Zurich, Switzerland, October 13, 2017.

Selvadurai, P.A. (2017) "Visual evolution of asperity contact area during the passage of slow shear ruptures in the laboratory", ***invited*** *Cargese Summer School*, Cargese, France, October 3, 2017.

Selvadurai, P.A. (2016) "Laboratory investigation into foreshock sequences and their relation to nucleation processes on a frictional fault", ***invited AEED Seminar Series***, Lawrence Livermore National Laboratory, Livermore, USA, August 23, 2016.

Selvadurai, P.A. (2016) "Numerical modeling of heterogeneous asperity distributions controlling the growth of shear rupture on a frictional fault", ***invited EPFL Mememto*****,** Lausanne, Switzerland, July 13, 2016.

Selvadurai, P.A. (2016) "Laboratory investigation into foreshock sequences and their relation to nucleation processes on a frictional fault", ***invited Seismological seminar series***, ETH Zurich, Switzerland, July 12, 2016.

Selvadurai, P.A. (2016) "Laboratory investigation into foreshock sequences and their relation to nucleation processes on a frictional fault", ***invited Geophysics seminar***, Lawrence Berkeley National Laboratory, Berkeley, USA, June 12, 2016.

Selvadurai, P.A. (2015) "Laboratory-developed contact models controlling instability on frictional faults", ***invited Berkeley Seismological Laboratory Seminar***, University of California, Berkeley, USA, March 3, 2015.

Selvadurai, P.A. (2014) "Laboratory Earthquakes: Glimpses into Precursory Phenomena", ***invited Research Seminar in Applied Mechanics***, McGill University, Montreal, December 23, 2014.

Selvadurai, P.A. (2013) "Direct measurement of contact area and seismic stress along a sliding interface", ***invited Research Seminar in Applied Mechanics***, McGill University, Montreal, August 28, 2013.

Selvadurai, P.A. (2012) "Laboratory Investigations into Micromechanical Mechanisms Controlling the Onset of Stick-Slip Instabilities", ***invited Geomechanics Research Symposium,*** McGill University, Montreal, March 3, 2012.

Technical Reports:

Selvadurai, A.P.S., Suvorov, A.P. and **Selvadurai, P.A.** (2014), Application of the COMSOL multi-physics code for coupled thermo-hydro-mechanical modeling of fractured rock mass subjected to glaciation load, *Technical Report Nuclear Waste Management Organization*, ON, Canada, TGS-XXX.

Selvadurai, P.A., Glaser, S.D. and Kiwan, R.H. (2013), "Laboratory Investigations into Micromechanical Mechanisms Controlling the Onset of Stick-slip Instabilities," *Berkeley Seismological Laboratory Annual Report*, 50-51.

Dissertations from Academic Institutions

Selvadurai, P.A. (2010), "Permeability of Indiana Limestone: Experiments and Theoretical Concepts for Interpretation of Results", *Master's Thesis at the Department of Civil Engineering and Applied Mechanics at McGill University*, Montreal, Quebec, Canada, H3A 2K6. pp. 108.

Selvadurai, P.A. (2015), "Laboratory studies of frictional sliding and the implications of precursory seismicity", *Doctoral dissertation at Civil and Environmental Engineering at University of California*, Berkeley, Berkeley, CA, USA. pp. 138.