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## RESEARCH INTERESTS

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Earthquake Mechanics – Seismology – Mineral and Rock Physics

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## EDUCATION

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### University of California, Berkeley, CA, 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 18<sup>th</sup>, 2015.

### McGill University, Montreal, Canada

- M.Sc., 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.

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## EXPERIENCE

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<b>Senior Researcher</b> ETH Zürich, Switzerland Laboratory Seismology Group Leader	2021- <i>Present</i>
<b>Postdoctoral Researcher</b> ETH Zürich, Switzerland	2017-2021
<b>Research Specialist</b> University of California, Berkeley, USA	2016
<b>Research Assistant</b> Lawrence Berkeley National Laboratory, Berkeley, USA	2011
<b>Consultant</b> Nuclear Waste Management Organization of Ontario, Toronto, CAN	Jan. 2011
<b>Laboratory Research Assistant</b> McGill University, Montréal, CAN	2006-2010

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## AWARDS

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

<b>Outstanding Student Paper Award in Seismology</b> American Geophysical Union	2013
<b>Award for Excellent Paper</b> International Association for Computer Methods and Advances in Geomechanics	2011
<b>Lady Jane Lewis Fellowship</b> University of California, Berkeley	2010

## GRANTS<sup>1</sup>

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<b>Swiss National Science Foundation</b> (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
<b>Swiss National Science Foundation</b> (200021_197366) Characterizing and understanding Enhanced Geothermal Systems (EGS) - novel tools and applications in a deep underground laboratory (co-PI)	2021
<b>Swiss National Science Foundation</b> (200021_192017) Advancing laboratory seismology for improving the forecasting of natural and induced earthquakes (co-PI)	2020
<b>NSERC Postgraduate Scholarships-Doctoral</b> (PGSD3-391943-2010)	2010

## CURRENT ADVISING

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Primary supervisor: H. Chen (PhD 2yr), S. Michail (PhD 4yr)  
 Co-supervisor: M. Rast (PhD, 4yr), M. Castelleano (PhD, 4yr), A. Salazar (PhD 4yr), N. Munro-Kagan (BSc, 3yr)

## STUDENTS SUPERVISED

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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

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<b>Lecturer (651-4025-00L) Rock Mechanics and Rock Engineering</b> ETH Zürich (Graduate-level)	2022-present
<b>Lecturer (651-4103-00L) Earthquakes II: Source physics</b> ETH Zürich (Graduate-level)	2018-present
<b>Teaching Assistant (CE 271): Sensors and Signal Interpretation</b> University of California, Berkeley (Graduate-level)	2013-2016
<b>Teaching Assistant (CIVE 207): Solid Mechanics</b> McGill University (Undergraduate-level)	2009

## PUBLICATIONS IN PEER-REVIEWED SCIENTIFIC JOURNALS

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<sup>1</sup> Please consult ORCID (<https://orcid.org/0000-0002-3846-8333>) for grant details

- Bianchi, P., **Selvadurai, P. A.**, Dal Zilio, L., Rast, M., Madonna, C., & Wiemer, S. (2024). Effects of Energy Dissipation on Precursory Seismicity During Earthquake Preparation. *Seismica*, 3(2). <https://doi.org/10.26443/seismica.v3i2.1417>
- Salazar Vásquez, A.F., **Selvadurai, P.A.**, Bianchi P., Rabaiotti, C., Germanovich, L.N., Madonna, C., Wiemer, S., (2024) Aseismic strain localization prior to failure and associated seismicity in crystalline rock. *Scientific Reports* 14, 29954 <https://doi.org/10.1038/s41598-024-75942-9>
- Obermann, A., Roskopf, M. Durand, V., Plenkers, K., Bröker, K., Rinaldi, A. P., Gholizadeh Doonechaly, N., Gischig, V., Zappone, A., Amann, F., Cocco, M., Hertrich, M., Jalali, M., Junker, J. S., Kästli, P., Ma, X., Maurer, H., Meier, M.-A., Schwarz, M., **Selvadurai, P.A.**, Villiger, L., Wiemer, S., Dal Zilio, L., Giardini, D. Seismic response of hectometer-1 scale fracture systems to hydraulic stimulation in the Bedretto Underground laboratory, Switzerland. *Journal of Geophysical Research: Solid Earth*. 129, e2024JB029836. <https://doi.org/10.1029/2024JB029836>
- 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. *Journal of Geophysical Research: Machine Learning and Computation*, 1, e2024JH000220. <https://doi.org/10.1029/2024JH000220>
- Bianchi, P., **Selvadurai, P.A.**, Salazar Vasquez, A., Dal Zilio, L., Madonna, C., Gerya, T., Weimer, S. (2024) Laboratory insights into localization prior to catastrophic failure in siliclastic rocks. *Rock Mechanics and Rock Engineering* 57, 5371–5395 (2024). <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. *Nature Communications* 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*, 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>
- Köpfl, 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., Köpfl, 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", submitted to *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

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 *Geophysical Journal International*) 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 for *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 CO<sub>2</sub>", *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 AEDD 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.