

CURRICULUM VITAE

Identification

Family name:	Lefebvre
Given name and initials:	René
University:	Institut national de la recherche scientifique
Country:	CANADA
Title or position:	Full professor
Department:	Centre Eau Terre Environnement

Areas of expertise

Groundwater, Aquifers, Groundwater resources, Contamination, Characterization, Piezocone, Numerical modeling, Multiphase flow, Hydrogeochemistry, Hydrogeophysics

Training

Diploma	Year	Discipline/Field	University
Ph.D.	1994	Geology (hydrogeology)	Université Laval
M.Sc.	1984	Geology (geochemistry)	University of Calgary
B.Sc.A.	1981	Geological engineering	Université Laval

Prizes & Recognitions

- May 2000: Earth Sciences Sector Merit Award, Natural Resources Canada, for contribution to the development of the hydrogeology research program of the Quebec Geoscientific Centre (Joint scientific program of INRS and the Geological Survey of Canada).
- December 2002: Head of the Public Service Award, Collaborative Working Relationships, Excellence in Service Delivery to the persons responsible of the project « Regional hydrogeology of the Basses-Laurentides fractured aquifers ».
- 2003: INRS Excellence in Research Award, jointly received with Pr. Richard Martel.
- 2008 to 2001: INRS administrative board member.
- March to April 2015: Herbette Fellowship to support a stay at Lausanne University, Switzerland.

CURRICULUM VITAE

- 2015: 2014 Editor's Citation for Excellence in Refereeing from Alberto Montanari, Editor of *Water Resources Research*, American Geophysical Union.
- 2016 Robert N. Farvolden Award from the Canadian Geotechnical Society and the Canadian National Chapter of the International Association of Hydrogeologists "to honour outstanding contributions to the disciplines of earth science and engineering that emphasize the role or importance of groundwater".
- *Prix Planète INRS 2017* received with 6 INRS colleagues for an excellent contribution to teaching in relation with the organization of a course on field characterization methods.

Research Contributions

Summary of contributions to research (total of 937):

• Papers in peer-reviewed scientific journals:	85 (7 invitations)
• Papers in fully peer-reviewed conference proceedings:	14
• Papers in conference proceedings:	117 (4 invitations)
• Papers in collective publication:	26
• Abstracts in conference proceedings:	257 (9 invitations)
• Oral communications without abstracts:	99 (43 invitations)
• Governmental publications:	15
• Scientific reports:	174
• M.Sc. and Ph.D. theses supervised or co-supervised:	66 (+4 on-going)

Papers in peer-reviewed scientific journals (42 since 2013):

Beaudry, C., Lefebvre, R., Rivard, C., Cloutier, V., submitted. Conceptual model of regional groundwater flow in a fractured rock aquifer system based on hydrogeochemistry (Montréal Est, Quebec, Canada). Manuscript TCWR-2017-0074, *Canadian Water Resources Journal*.

Janos, D., Molson, J., Lefebvre, R., submitted. Regional groundwater flow dynamics and residence times in Chaudière-Appalaches, Québec, Canada: Insights from numerical simulations. Manuscript TCWR-2017-0071, *Canadian Water Resources J.*

Tremblay, L., Lefebvre, R., Cloutier, V., Clark, I.D., submitted. Effects of groundwater geochemical heterogeneity on landfill leachate natural attenuation. Manuscript 3714349, *Geofluids*.

85. Rivard, C., Bordeleau, G., Lavoie, D., Lefebvre, R., Malet, X., accepted. Can groundwater sampling techniques used in observation wells influence methane concentrations and isotopes? Manuscript EMAS-D-17-01989, *Environmental Monitoring and Assessment*.

84. Bordeleau, G., Rivard, C., Lavoie, D., Lefebvre, R., Malet, X., Ladevèze, P., accepted. Geochemistry of groundwater in the Saint-Édouard area, Quebec, Canada, and its influence on the distribution of methane in shallow aquifers. Manuscript APGEO-D-17-00130, *Applied Geochemistry*.

CURRICULUM VITAE

- 83.** Ladevèze, P., Séjourné, S., Rivard, C., Lavoie, D., **Lefebvre**, R., Rouleau, A., accepted. Defining the natural fracture network in a shale gas play and its cover succession; the case of the Utica Shale in eastern Canada. Manuscript SG-D-17-00079, *J. of Structural Geology*.
- 82.** Longpré-Girard, M., Martel, R., Robert, T., **Lefebvre**, R., Lauzon, J.-M., accepted. Surfactant foam selection for enhanced LNAPL recovery in contaminated aquifers. Accepted by *Ground Water Monitoring & Remediation*.
- 81.** Rey, N., Rosa, E., Cloutier, V., **Lefebvre**, R., in press. Using water stable isotopes for tracing surface and groundwater flow systems in the Barlow-Ojibway Clay Belt, Quebec, Canada. Manuscript TCWR-2017-0012.R2, *Canadian Water Resources J.*
- 80.** Rivard, C., Bordeleau, G., Lavoie, D., **Lefebvre**, R., Malet, X., in press. Temporal variations of methane concentration and isotopic composition in groundwater of the St. Lawrence Lowlands, eastern Canada. Manuscript HJ-2017-4679.R2, *Hydrogeology J.*
- 79.** Ahad, J.M.E., Pakdel, H., Lavoie, D., **Lefebvre**, R., Peru, K.M., Headly, J.V., 2018. Naphthenic acids in groundwater overlying undeveloped shale gas and tight oil reservoirs. *Chemosphere*, 191 (2018), 664-672, doi: 10.1016/j.chemosphere.2017.10.015.
- 78.** Paradis, D. Ballard, J.M., **Lefebvre**, R. Savard, M.M., 2017. Multi-scale nitrate transport in a sandstone aquifer system under intensive agriculture. *Hydrogeology J.*, 21 p., doi: 10.1007/s10040-017-1668-z.
- 77.** Robert, T., Martel, R., **Lefebvre**, R., Lauzon, J.-M., Morin, A., 2017. Impact of heterogeneous properties of soil and LNAPL on surfactant-enhanced capillary desaturation. *J. of Contaminant Hydrology.*, 204C, 57-65, doi: 10.1016/j.jconhyd.2017.07.006.
- 76.** Lahmira, B., **Lefebvre**, R., Aubertin, M., Bussièrre, B., 2017. Effect of material variability and compacted layers on transfer processes in heterogeneous waste rock piles. *J. of Contaminant Hydrology*, 204C, 66-78, doi: 10.1016/j.jconhyd.2017.07.004.
- 75.** Cerutti, J., Lavoie, R., **Lefebvre**, R., 2017. Development of a knowledge base to support the consideration of groundwater protection in land-use planning. *Sustainable Water Resources Management*, 13 p., doi: 10.1007/s40899-017-0175-7.
- *74.** **Lefebvre**, R., 2017. Mechanisms leading to potential impacts of shale gas development on groundwater quality. *WIREs Water*, 4(1), January/February 2017, 15 p., doi: 10.1002/wat2.1188.
- 73.** Raynauld, M., Peel, M., **Lefebvre**, R., Molson, J., Crow, H., Ahad, J., Ouellet, M., Aquilina, L., 2016. Understanding shallow and deep flow for assessing the risk of hydrocarbon development to groundwater quality. *J. of Marine and Petroleum Geology*, 78C, 728-737, doi: 10.1016/j.marpetgeo.2016.09.026.
- 72.** Longpré-Girard, M., Martel, R., Robert, T., **Lefebvre**, R., Lauzon, J.-M., 2016. 2D sandbox experiments of surfactant foams for mobility control and enhanced LNAPL recovery in layered soils. *J. of Contaminant Hydrology*, 193, 63-73, doi: 10.1016/j.jconhyd.2016.09.001.
- 71.** **Lefebvre**, R., Lahmira, B., Löbner, W., 2016. Atmospheric control of radon emissions from a waste rock dump. *Environmental Geotechnics*, Theme issue on *Soil-Atmosphere Interactions*, 12 p., doi: 10.1680/jenge.15.00066.
- *70.** Paradis, D., **Lefebvre**, R., Gloaguen, E., Giroux, B., 2016. Comparison of slug and pumping tests for hydraulic tomography experiments: A practical perspective. *Environmental Earth Sciences*, 76: 1159, 13 p., doi: 10.1007/s12665-016-5935-4.
- 69.** Pétre, M.A., Rivera, A., **Lefebvre**, R., Hendry, M.J., Folnagy, A.J.B., 2016. A unified hydrogeological conceptual model of the Milk River transboundary aquifer, traversing Alberta (Canada) and Montana (USA). *Hydrogeology J.*, 24(7), 1847-1871, doi: 10.1007/s10040-016-1433-8.

CURRICULUM VITAE

68. Robert, T., Martel, R., **Lefebvre**, R., Lauzon, J.-M., Morin, A., 2016. Field tracer test for the design of LNAPL source zone surfactant flushing. *Ground Water Monitoring and Remediation*, 36(2), 68-82, doi: 10.1111/gwmr.12164.
67. Gosselin, J.S., Rivard, C., Martel, R., **Lefebvre**, R., 2016. Application limits of the interpretation of near-surface temperature time series to assess groundwater recharge. *J. of Hydrology* 538, 96-108, doi: 10.1016/j.jhydrol.2016.03.055.
66. Paradis, D., Gloaguen, E., **Lefebvre**, R., Giroux, B., 2016b. A field proof-of-concept of tomographic slug tests in an anisotropic littoral aquifer. *J. of Hydrology*, 536 (2016), 61–73, doi: 10.1016/j.jhydrol.2016.02.041.
65. Paradis, D., Vigneault, H., **Lefebvre**, R., Savard, M.M., Ballard, J.-M., Qian, B., 2016a. Groundwater nitrate concentration evolution under climate change and agricultural adaptation scenarios: Prince Edward Island, Canada. *Earth System Dynamics*, 7, 183-202, doi: 10.5194/esd-7-183-2016.
64. Lahmira, B., **Lefebvre**, R., Aubertin, M., Bussi re, B., 2016. Effect of heterogeneity and anisotropy related to the construction method on transfer processes in waste rock piles. *J. of Contaminant Hydrology*, 184, 35–49, doi: 10.1016/j.jconhyd.2015.12.002.
63. Lahmira, B., **Lefebvre**, R., 2015. Numerical modeling of transfer processes in a waste rock pile undergoing the temporal evolution of its heterogeneous material properties. *IJMRE-Int. J. of Mining, Reclamation and Environment*, 29(6), 499-520, doi: 10.1080/17480930.2014.889362.
62. Paradis, D., Gloaguen, E., **Lefebvre**, R., Giroux, B., 2015. Resolution analysis of tomographic slug test head data: two-dimensional radial case. *Water Resources Research*., 51(4), 2356-2376, doi: 10.1002/2013WR014785.
61. Moritz, A., H lie, J.F., Pinti, D.L., Larocque, M., Barnatche, D., Retailleau, S., **Lefebvre**, R., G linas, Y., 2015. Methane baseline concentrations and sources in shallow aquifers from the shale gas-prone region of the St. Lawrence Lowlands (Quebec, Canada). *Environmental Science & Technology*, 49(7), 4765-4771, doi: 10.1021/acs.est.5b00443.
60. **Lefebvre**, R., Gleeson, T., McKenzie, J.M., Gassiat, C., 2015. Reply to comment by S. A. Flewelling and M. Sharma on "Hydraulic fracturing in faulted sedimentary basins: Numerical simulation of potential contamination of shallow aquifers over long time scales". *Water Resources Research*, 51(3), 1877-1882, doi: 10.1002/2014WR016698.
59. P tr , M.A., Rivera, A., **Lefebvre**, R., 2015. Three-dimensional unified geological model of the Milk River Transboundary Aquifer (Alberta, Canada-Montana, USA). *Canadian J. of Earth Sciences*, 52(2): 96-111, doi: 10.1139/cjes-2014-0079.
58. Paradis, D., **Lefebvre**, R., Gloaguen, E., Rivera, A., 2015. Predicting hydrofacies and hydraulic conductivity from direct-push data using a data-driven relevance vector machine approach: Motivations, algorithms and application. *Water Resources Research*, 51(1), 481-505, doi: 10.1002/2014WR015452.
57. Lahmira, B., **Lefebvre**, R., Hockley, D., Phillip, M., 2014. Atmospheric controls on gas flow directions in a waste rock dump. *Vadoze Zone J.*, October 2014, 13(10), doi:10.2136/vzj2014.03.0032.
- *56. Paradis, D., Tremblay, L., **Lefebvre**, R., Gloaguen, E., Rivera, A., Parent, M., Ballard, J.M., Michaud, Y., Brunet, P., 2014. Field characterization and data integration to define the hydraulic heterogeneity of a shallow granular aquifer at a sub-watershed scale. *Environmental Earth Sciences*, 72 (5), Sept. 2014, 1325-1348, doi: 10.1007/s12665-014-3318-2.
55. Pinti, D.L., Retailleau, S., Barnatche, D., Moreira, F., Moritz, A., Larocque, M., G linas, Y., **Lefebvre**, R., H lie, J.F., Valadez, A., 2014. ²²²Rn activity in groundwater of the St. Lawrence Lowlands, Quebec, eastern Canada: relation with local geology and health hazard. *J. of Environmental Radioactivity*, 136 (2014), 206-214, doi: 10.1016/j.jenvrad.2014.05.021.

CURRICULUM VITAE

54. Sauvageau, M., Gloaguen, E., Claprood, M., **Lefebvre**, R., Bêche, M., 2014. Multimodal reservoir porosity simulation: An application to a tight oil reservoir. *J. of Applied Geophysics*, 107, August 2014, 71-79, doi: 10.1016/j.jappgeo.2014.05.007.
53. Tran Ngoc, T.D., **Lefebvre**, R., Konstantinovskaya, E., Malo, M., 2014. Characterization of deep saline aquifers in the Bécancour area, St. Lawrence Lowlands, Québec, Canada: implications for CO₂ geological storage. *Environmental Earth Sciences*, 72(1), 119-146, doi: 10.1007/s12665-013-2941-7.
52. Ruggeri, P., Gloaguen, E., **Lefebvre**, R., Irving, J., Holliger, K., 2014. Integration of hydrological and geophysical data beyond the local scale: Application of Bayesian sequential simulation to field data from the Saint-Lambert-de-Lauzon site, Québec, Canada. *J. of Hydrology*, 514, 271-280, doi: 10.1016/j.jhydrol.2014.04.031.
51. Tremblay, L., **Lefebvre**, R., Paradis, D., Gloaguen, E., 2014. Conceptual model of leachate migration in a granular aquifer derived from the integration of multi-source characterization data (St-Lambert, Canada). *Hydrogeology J.*, 22(3), 587-608, doi: 10.1007/s10040-013-1065-1.
- *50. Rivard, C., Lavoie, D., **Lefebvre**, R., Séjourné, S., Lamontagne, C., Johnson, E.G., Duchesne, M.J., 2014. An overview of Canadian shale gas production and environmental concerns. *International Journal of Coal Geology (IJCG)*, 126 (2014), 64-76, doi: 10.1016/j.coal.2013.12.004.
- *49. Lavoie, D., Rivard, C., **Lefebvre**, R., Séjourné, S., Thériault, R., Duchesne, M.J., Ahad, J., Wang, B., Benoit, N., Lamontagne, C., 2014. The Utica Shale and gas play in southern Quebec: Geological and hydrogeological synthesis and methodological approaches to groundwater risk evaluation. *International Journal of Coal Geology (IJCG)*, 126 (2014), 77-91, doi: 10.1016/j.coal.2013.10.011.
48. Rivard, C., **Lefebvre**, R., Paradis, D., 2014. Regional recharge estimation using multiple methods: an application in the Annapolis Valley, Nova Scotia (Canada). *Environmental Earth Sciences*, 71(3), 1389–1408, doi: 10.1007/s12665-013-2545-2.
47. Gassiat, C., Gleeson, T., **Lefebvre**, R., McKenzie, J., 2013. Hydraulic fracturing in faulted sedimentary basins: Numerical simulation of potential contamination of shallow aquifers over long time scales. Manuscript online November 5, 2013, *Water Resources Research*, 49(12), 8310-8327, doi: 10.1002/2013WR014287.
46. Tran Ngoc, T.D., Doughty, C., **Lefebvre**, R., Malo, M., 2013. Injectivity of carbon dioxide in the St. Lawrence Platform, Quebec (Canada): A sensitivity study. *Greenhouse Gases: Science & Technology (GHGS&T)*, 3, 516-540, doi: 10.1002/ghg.1387.
45. Ruggeri, P., Irving, J., Holliger, K., Gloaguen, E., **Lefebvre**, R., 2013. Hydrogeophysical data integration at larger scales: Application of Bayesian sequential simulation for the characterization of heterogeneous alluvial aquifers. *The Leading Edge*, July 2013, 766-774, doi: 10.1190/tle32070766.1.
44. Paradis, D., **Lefebvre**, R., 2013. Single-well interference slug tests to assess the vertical hydraulic conductivity of unconsolidated aquifers. *J. of Hydrology*, 478, 102-118, doi: 10.1016/j.jhydrol.2012.11.047.

Papers in fully peer-reviewed conference proceedings (2 since 2013):

14. Raynauld, M., Peel, M., **Lefebvre**, R., Molson, J., Crow, H., Ahad, J., Ouellet, M., Gloaguen, E., Aquilina, L., 2015. Understanding shallow and deep flow to assess the risk of hydrocarbon development on groundwater quality. Extended abstract, *First EAGE / TNO Workshop: Basin Hydrodynamic Systems in Relations to their Contained Resources*, 6-8 May 2015, Utrecht, The Netherlands, 4 pp.
13. Gloaguen, E., Sauvageau, M., Claprood, M., Dubreuil-Boisclair, C., **Lefebvre**, R., 2013. Multi-modal porosity reservoir simulation - An application to a tight oil field. Extended abstract, *75th EAGE Conference & Exhibition incorporating SPE EUROPEC 2013*, Session: Reservoir Characterisation - Case Studies, London, UK June 10-13, 2013, doi: 10.3997/2214-4609.20130521.

CURRICULUM VITAE

Papers in conference proceedings (11 since 2013):

117. Ango, H., Delestre, M., Ousmane, B., **Lefebvre**, R., 2017. Assessment of groundwater resources to support wildlife in the Parc W, Niger. *GeoOttawa 2017, 70th Canadian Geotechnical Conference and 12th Joint CGS/IAH-CNC Groundwater Conference*, Canadian Geotechnical Society (CGS) and Canadian National Chapter of the International Association of Hydrogeologists (IAH-CNC), October 1-4, 2017, Ottawa, Canada, 8 p.
116. Rivard, C., Lavoie, D., Pinet, N., Duchesne, M.J., Bordeleau, G., Séjourné, S., Huchet, F., **Lefebvre**, R., Brake, V., Crow, H., Malet, X., 2017. A study of aquifer vulnerability to hydrocarbon development in southern New Brunswick. *GeoOttawa 2017, 70th Canadian Geotechnical Conference and 12th Joint CGS/IAH-CNC Groundwater Conference*, Canadian Geotechnical Society (CGS) and Canadian National Chapter of the International Association of Hydrogeologists (IAH-CNC), October 1-4, 2017, Ottawa, Canada, 8 p.
115. Huchet, F., Rivard, C., **Lefebvre**, R., 2017. Hydrogeological characterisation above two gas fields, Moncton sub-basin, southern New Brunswick. *GeoOttawa 2017, 70th Canadian Geotechnical Conference and 12th Joint CGS/IAH-CNC Groundwater Conference*, Canadian Geotechnical Society (CGS) and Canadian National Chapter of the International Association of Hydrogeologists (IAH-CNC), October 1-4, 2017, Ottawa, Canada, 8 p.
114. Gloaguen, E., Sauvageau, M., **Lefebvre**, R., 2014. On the importance of using stochastic seismic inversion in reservoir modelling: An application on a tight oil reservoir. 2nd EAGE Integrated Reservoir Modelling Conference - Uncertainty Management: Are we Doing it Right Dubai, United Arab Emirates, 16-19 Nov. 2014.
113. Thériault, R., Rivard, C., Savard, M., **Lefebvre**, R., 2013. Nitrate sources and factors controlling its distribution in agricultural lands and groundwater in two small catchments in southern Quebec. *GéoMontréal2013, 66th Canadian Geotechnical Conference and the 11th Joint CGS/IAH-CNC Groundwater Conference*, Montreal, Quebec, Canada, Sept. 29 to Oct. 3, 2013.
112. **Lefebvre**, R., Rivard, C., Carrier, M.-A., Parent, M., Benoit, N., Laurencelle, M., Beaudry, C., 2013. Modèles conceptuels géologiques et hydrogéologiques de la Montérégie Est, sud-ouest du Québec. *GéoMontréal2013, 66th Canadian Geotechnical Conference and the 11th Joint CGS/IAH-CNC Groundwater Conference*, Montreal, Quebec, Canada, Sept. 29 to Oct. 3, 2013.
111. Séjourné, S., **Lefebvre**, R., Lavoie, D., Malet, X., 2013. Geologic and hydrogeologic understanding of caprock strata overlying the Utica Shale in the St. Lawrence Lowlands (Quebec, Canada). *GéoMontréal2013, 66th Canadian Geotechnical Conference and the 11th Joint CGS/IAH-CNC Groundwater Conference*, Montreal, Quebec, Canada, Sept. 29 to Oct. 3, 2013.
110. Raynauld, M., Crow, H., Fagnan, N., **Lefebvre**, R., Gloaguen, E., Molson, J.W., Benoit, N., 2013. Caractérisation des conditions hydrogéologiques au-dessus du réservoir pétrolier d'Haldimand, Gaspé, Québec. *GéoMontréal2013, 66th Canadian Geotechnical Conference and the 11th Joint CGS/IAH-CNC Groundwater Conference*, Montreal, Quebec, Canada, Sept. 29 to Oct. 3, 2013.
109. Laurencelle, M., **Lefebvre**, R., Rivard, C., Parent, M., Ladevèze, P., Benoit, N., Carrier, M.-A., 2013. Modeling the evolution of the regional fractured-rock aquifer system in the Northern Lake Champlain watershed following last deglaciation. *GéoMontréal2013, 66th Canadian Geotechnical Conference and the 11th Joint CGS/IAH-CNC Groundwater Conference*, Montreal, Quebec, Canada, Sept. 29 to Oct. 3, 2013.
108. Séjourné, S., **Lefebvre**, R., Lavoie, D., Malet, X., 2013. Geological and hydrogeological synthesis of the Utica Shale and the overlying strata in southern Quebec based on public data in a context of a moratorium on exploration. Integration GeoConvention 2013, CSEG, CSPG and CWLS, Calgary, Alberta, Canada, May 6-10, 2013, 5 p.

CURRICULUM VITAE

107. Lavoie, D., Thériault, R., Séjourné, S., **Lefebvre, R.**, 2013. The Upper Ordovician Shales in Eastern Canada – Regional Variations on Dry Gas and Liquids domains. Integration GeoConvention 2013, CSEG, CSPG and CWLS, Calgary, Alberta, Canada, May 6-10, 2013, 5 p.

Papers in collective publications (1 since 2013; 26 total)

Abstracts in conference proceedings (74 since 2013; 257 total)

Oral communications without abstract (35 since 2013; 99 total)

Governmental publications (2 since 2013; 15 total)

Scientific reports (30 since 2013; 174 total)

Supervision of highly trained personnel since 2013:

Postdoctoral researchers: 3 (1 presently; 6 total).

Ph.D. students: 10 (4 presently; 19 au total).

M.Sc. students: 13 (1 presently; 51 total)

Summer interns (B.Sc. or M.Sc.): 6 (0 presently; 42 total).

Research professionals: 7 (2 presently; 34 total).