

# LAWRENCE C. MURDOCH

CLEMSON, SOUTH CAROLINA  
PHONE: 864 356 8349 □

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## WORK EXPERIENCE

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- **3/94 – Present: FRx, Inc.**

*President, Clemson*

Principal and founder of the company, which commercially provides new and recently developed technology, especially in remediation of contaminated soil. In addition, serves as Chief Technology Officer and Director of Research.

- **2/97 – Present: Clemson University**

*Professor, Department of Geosciences*

*Associate Professor, Department of Geosciences*

*Assistant Professor, Department of Geosciences*

Dr. Murdoch's teaching and research interests are in hydrogeology. He teaches an introductory course in applied hydrogeology, and advanced courses in the hydrogeology of U.S. aquifers and fractured rock hydrology. He also teaches a course in methods for analyzing geological processes, and he organizes the hydro field camp. Dr. Murdoch's recent research activities have included projects in environmental remediation, aquifer characterization, interaction between ground water and surface water, and effects of changing land use. He developed techniques for creating and applying hydraulic fractures for environmental applications, and more recently he has been developing hydromechanical techniques for characterizing rock aquifers. Many of his projects involve innovative field or laboratory techniques with modeling coupled processes of flow, transport, and deformation.

- **8/86 – 12/96: University of Cincinnati**

*Director of Research, Center for Geoenvironmental Science and Technology*

*Associate Research Professor, Department of Civil and Environmental Engineering*

*Geohydrology Group Leader, Center for GeoEnvironmental Science and Technology*

*Research Associate*

Conceived the idea of using hydraulic fracturing as a soil remediation tool. Designed and executed experiments to prove the concept, identified potential applications, built equipment to perform the methods, and demonstrated technology at multiple contaminated sites. Directed the efforts of up to 40 people in support of US EPA contracts to the University to operate the Center Hill Laboratory. Published several articles and papers documenting the results.

## EDUCATION

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- Ph.D., Geology, University of Cincinnati
- M.S., Environmental Science, University of Cincinnati
- M.S., Geology, University of Cincinnati
- B.S., Geology, Penn State University

## PROFESIONAL QUALIFICATIONS

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- Professional Geologist, Indiana, No. 1421

## CERTIFICATIONS

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- Hazardous Waste Site Worker (40 hr HAZWPR)
- US DOE Radiological Worker I & II

## AFFILIATIONS

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- National Groundwater Association
- Affiliate Member, Society Petroleum Engineers
- Member, National Water Well Association
- Member, American Geophysical Union
- Member, Association of Engineering Geologists
- Affiliate Member, Society of Civil Engineers
- Member, Professional Geologists of Indiana

## HONORS / AWARDS

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- Board of Trustees Award for Faculty Excellence, 2008
- Visiting Scientist, Geological Survey of Denmark, Copenhagen, Spring 2005
- Board of Trustees Award for Faculty Excellence, 2003
- Board of Trustees Award for Faculty Excellence, 2001
- NSF CAREER Award, 1999
- Board of Trustees Award for Faculty Excellence, 1999

## COURSES TAUGHT

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- Geol 850, Site Assessment and Remediation
- Geol 408/608, Applied Hydrogeology
- Geol 415/615, Method of Analysing Geological Processes
- Geol 816, Aquifer Systems
- Geol 475/675, Hydrogeology Field Camp
- Geol 818, Hydrology and Mechanics of Fractured Media S'00,S'02

## SELECTED PUBLICATIONS / PRESENTATIONS

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- Murdoch, L.C. and others. Remediation of organic chemicals in the vadose zone, in Vadose Zone, Science and Technology Solutions. Chapter 7. pp 948-1247. R.Falta and B. Looney eds. Battelle Press, 2000.
- Murdoch, L.C., D. Wilson, K. Savage, W. Slack, and J. Uber. Alternative Methods for Fluid Delivery and Recovery. USEPA/625/R-94/003, 1995.
- Murdoch, L.C. Hydraulic and impulse fracturing for low permeability soils, Chapter in Petroleum Contaminated Low Permeability Soil, American Petroleum Institute Publication 4631, 1995.

- Beljin, M. and L.C. Murdoch. Analytical solutions to the performance of interceptor trenches and drains, 1995. International Ground Water Modeling Center, Golden, CO.
- Murdoch, L.C. and W.W. Slack. Forms of hydraulic fractures in shallow, fine-grained formations. *Journal of Geoenvironmental and Geotechnical Engineering*. v. 128, no. 6, p. 479-487
- Murdoch, L.C. Mechanical analysis of an idealized hydraulic fracture at shallow depths. *Journal of Geoenvironmental and Geotechnical Engineering*. v. 128, no. 6, p. 488-495.
- Roulier, Mike, Mark Kemper, Souhail Al-Abed, Larry Murdoch, and Wendy Davis-Hoover. Feasibility of electrokinetic soil remediation in horizontal Lasagna cells, *Journal of Hazardous Materials*, B77, 161-176. 2000.
- Murdoch, L.C., W.W. Slack, W.G. Harrar, R.L. Siegrist. Embedded sidewall samplers and sensors to monitor the subsurface. *Ground Water*, v.38, n. 5. p. 657-664, 2000.
- Uber, J.G. and L.C. Murdoch. Evaluation of hopscotch method for transient groundwater flow. *J. Hydraul. Eng., ASCE*, v. 126, n. 8, August 2000, p. 615-626.
- Murdoch, L.C., W.W. Slack, W. Harrar, B. Nilsson, and R. Siegrist. Sidewall sensors for monitoring fractured clay till. *Journal of Nordic Hydrology*, 30, no. 4/5, 1999.
- Chen, J-L, Al-Abed, Bryndzia, and Murdoch, L.C. Effects of cation transport and partitioning during a field test of electroosmosis. *Water Resources Research*, v. 35, no. 2, pg. 3841-3851, Dec. 1999.
- Siegrist R.L., K. S. Lowe, L.C. Murdoch, T.L. Case, and D. A. Pickering. In situ oxidization by fracture emplaced reactive solids. *Jour of Environ. Eng.*, v. 125, n. 5, 429-440. 1999.
- Chen, J-L. and Murdoch, L.C. In-situ electroosmosis between horizontal electrodes: a field test. *J. Geotech. And Geoenviron. Eng.*, v. 125, no. 12, 1090-1100. 1999.
- Murdoch, L.C. and J-L. Chen. Effects of conductive fractures during in situ electroosmosis: *Journal of Hazardous Materials*, 55, 239-262, 1997.
- Chen, J-L. and Murdoch, L.C. In-situ electroosmosis between horizontal electrodes: a field test. *J. Geotech. And Geoenviron. Eng.*, v. 125, no. 12, 1090-1100. 1999.
- Murdoch, L.C. Forms of hydraulic fractures created during a field test in fine-grained glacial drift, *Quarterly Journal of Engineering Geology*, 28, 23-35, 1995.
- Murdoch, L.C. and J. Franco. Analysis of constant head wells using instantaneous source functions, *Water Resources Research* v. 30, (1) 117-124, 1994.
- Murdoch, L.C. Transient analysis of an interceptor trench, *Water Resources Research*, 30(11), 3023-3032, 1994.
- Vesper, S. L.C. Murdoch, S. Hayes, and W. Davis-Hoover. Slow-release oxygen sources for bio-remediation in soils. *Journal Hazardous Materials*, 36, 265-274, 1994.
- Murdoch, L.C. Hydraulic fracturing of soil during laboratory experiments: methods and observations, *Geotechnique*, 43(2), 255-265, 1993.
- Murdoch, L.C. Hydraulic fracturing of soil during laboratory experiments: propagation, *Geotechnique*, 43(2), 266-276, 1993.
- Murdoch, L.C. Hydraulic fracturing of soil during laboratory experiments: theoretical analysis, *Geotechnique*, 43(2), 277-287, 1993.