



Dr. Douglas Mackay

- Adjunct Professor, Retired, Department of Land, Air and Water Resources, University of California, Davis
- dmmackay@ucdavis.edu

Doug Mackay retired from UC Davis on 7/1/17, but not from research, which continues, albeit at a more leisurely pace. Past research by a host of students and staff has addressed many aspects of groundwater contamination and decontamination, often utilizing highly detailed field studies of existing groundwater contamination and/or highly controlled field experiments. Both were conducted with resolution approaching that of laboratory studies but at scales and often including processes impossible to represent in laboratory studies. In recent years, research has focused on:

- Highly controlled field experiments on fate of methane and ethanol-blended gasolines released into the vadose zone (now complete)
- Evaluation of natural source zone depletion (NSZD) at petroleum hydrocarbon release sites with lingering contamination (ongoing)
- Full-scale application of sulfate release for enhancement of in situ biodegradation of petroleum hydrocarbons in source zone (ongoing)

Contaminants investigated to date include:

- Petroleum hydrocarbons (e.g. gasoline, ethanol-blended gasolines [gasohol], oil, crude oil)
- Fuel oxygenates (e.g. in reformulated gasolines)
- Ethanol
- Chlorinated solvents
- Pesticides
- Complex mixtures

Topics that we've have addressed via field research in the past include:

- Transport, sorption and degradation of various organic contaminants in sandy aquifers
- Factors limiting pump & treat remediation of contaminated groundwater
- Comparison of pulsed and continuous pumping for groundwater remediation by pump & treat technologies
- Pesticide transport and sorption in groundwater
- Remediation of groundwater via various configurations of permeable reactive biobarriers
 - aerobic PRBs using diffusive oxygen releasers or solid oxygen sources
 - anaerobic PRBs using diffusive hydrogen release, zero valent iron, gypsum as sulfate source
- Flushing of a high-concentration, multi-component organic/inorganic contaminant plume from a granular aquifer overlying a fractured aquitard
- Vulnerability of Mexico City's aquifer to contamination

Selected Papers

Selected Publications

Buscheck, T., D. Mackay, C. Paradis, R. Schmidt, N. de Siewes. Sulfate Delivery Using Permeable Filled Borings Accelerates Hydrocarbon Biodegradation in Groundwater. *Ground Water Monitoring and Remediation*. Published 11 June 2019. <https://doi.org/10.1111/gwmmr.12346>

Mackay, D., Hathaway, E., de Siewes, N., Zhang, H., Rasa, E., Paradis, C., Schmidt, R., Peng, J., Buscheck, T. & Sihota, N. Comparing Natural Source Zone Depletion Pathways at a Fuel Release Site. Mar 1 2018, *Groundwater Monitoring and Remediation*. 38, 2, p. 24-39

Chu, M. Y. J., Bennett, P. J., Dolan, M. E., Hyman, M. R., Peacock, A. D., Bodour, A., Anderson, R. H., Mackay, D. & Goltz, M. N. Concurrent Treatment of 1,4-Dioxane and Chlorinated Aliphatics in a Groundwater Recirculation System Via Aerobic Cometabolism. Jun 1 2018, *Groundwater Monitoring and Remediation*. 38, 3, p. 53-64

Felice, M. L., Schmidt, R., Peng, J., de Siewes, N. R., Scow, K. M. & Mackay, D. Methane-oxidizing bacteria communities shift to attenuate a controlled vadose zone methane release. Jan 1 2018, *Vadose Zone Journal*. 17, 1, 180089.

Felice, M., de Siewes, N., Peng, J., Schmidt, R., Buelow, M., Jourabchi, P., Scow, K. M. & Mackay, D. Methane transport during a controlled release in the vadose zone. Feb 1 2018, *Vadose Zone Journal*. 17, 1, 180028.

Mackay, D., Paradis, C., Buscheck, T., Daniels, E., Hathaway, E., de Siewes, N., Rasa, E., Schmidt, R. & Peng, J. Methods to Estimate Source Zone Depletion of Fuel Releases by Groundwater Flow. Dec 1 2018, *Groundwater Monitoring and Remediation*. 38, 1, p. 26-41

Impacts of an ethanol-blended fuel release on groundwater and fate of produced methane: Simulation of field observations

Rasa, E., Bekins, B. A., Mackay, D., De Siewes, N. R., Wilson, J. T., Feris, K. P., Wood, I. A. & Scow, K. M. Impacts of an ethanol-blended fuel release on groundwater and fate of produced methane: Simulation of field observations. Aug 9 2013, *Water Resources Research*. 49, 8, p. 4907-4926

Rasa, E., Foglia, L., Mackay, D. & Scow, K. M. Incidence de différentes observations de déplacement sur des résultats de modélisation inverse: Cas d'un de test de traçage longue durée suivi à haute résolution. Nov 1 2013, *Hydrogeology Journal*. 21, 7, p. 1539-1554

Key, K. C., Sublette, K. L., Duncan, K., Mackay, D., Scow, K. M. & Ogles, D. Using DNA-stable isotope probing to identify MTBE- and TBA-degrading microorganisms in contaminated groundwater. Sep 1 2013, *Groundwater Monitoring and Remediation*. 33, 4, p. 57-68

North, K. P., Mackay, D., Annable, M. D., Sublette, K. L., Davis, G., Holland, R. B., Petersen, D. & Scow, K. M. An ex situ evaluation of TBA- and MTBE-baited bio-traps. Aug 1 2012, *Water Research*. 46, 12, p. 3879-3888

North, K. P., Mackay, D., Kayne, J. S., Petersen, D., Rasa, E., Rastegarzadeh, L., Holland, R. B. & Scow, K. M. In Situ Biotreatment of TBA with Recirculation/Oxygenation. Jun 1 2012, *Ground Water Monitoring and Remediation*. 32, 3, p. 52-62

Mackay, D., Einarson, M. D., Kaiser, P. M., Nozawa-Inoue, M., Goyal, S., Chakraborty, I., Rasa, E. & Scow, K. M. Mass Discharge in a Tracer Plume: Evaluation of the Theissen Polygon Method. Nov 1 2012, *Ground Water*. 50, 6, p. 895-907

Kline, K. R., Clark, J. F., Rastegarzadeh, L., Nelson, Y. M. & Mackay, D. Importance of exposure history when using single well push-pull tests to quantify in situ ethanol biodegradation rates. Jun 1 2011, *Ground Water Monitoring and Remediation*. 31, 3, p. 103-110

Rasa, E., Chapman, S. W., Bekins, B. A., Fogg, G. E., Scow, K. M. & Mackay, D. Role of back diffusion and biodegradation reactions in sustaining an MTBE/TBA plume in alluvial media. Nov 1 2011, In : *Journal of Contaminant Hydrology*. 126, 3-4, p. 235-247

Einarson, M. D., Mackay, D. M. & Bennett, P. J. Sampling transects for affordable, high-resolution plume characterization and monitoring. Nov 1 2010, *Ground Water*. 48, 6, p. 805-808

Beller, H. R., Kane, S. R., Legler, T. C., Mckelvie, J. R., Lollar, B. S., Pearson, F., Balsler, L. & Mackay, D. Comparative assessments of benzene, toluene, and xylene natural attenuation by quantitative polymerase chain reaction analysis of a catabolic gene, signature metabolites, and compound-specific isotope analysis. Aug 15 2008, *Environmental Science and Technology*. 42, 16, p. 6065-6072