

Energy Geosciences Division, MS 74-R316C
Lawrence Berkeley National Laboratory
University of California
Berkeley, CA 94720

Phone: (510) 486-5748
Fax: (510) 486-5686
E-mail: QZhou@lbl.gov
<https://eesa.lbl.gov/profiles/quanlin-zhou/>

1. EDUCATION AND DEGREES

1996 – 1999	Ph.D. in Civil & Environmental Engineering Technion-Israel Institute of Technology, Haifa, Israel
1987 – 1990	M. Eng. in Hydrology and Water Resources Hohai University, Nanjing, China.
1983 – 1987	B. Eng. in Hydrology and Water Resources Hohai University, Nanjing, China

2. EMPLOYMENT HISTORY

01/2012 – Present	Geological Staff Scientist (Career), LBNL
11/2008 – 12/2011	Geological Research Scientist (Career), LBNL
06/2006 – 10/2008	Geological Research Scientist (Career-Track), LBNL
09/2002 – 06/2005	
03/2001 – 09/2002	Geological Postdoctoral Fellow Energy Geosciences Division Lawrence Berkeley National Laboratory (LBNL) 1 Cyclotron Road, MS 74-316C, Berkeley, CA 94720
06/2005 – 06/2006	Senior Modeler, ETIC Engineering Inc. 1333 Broadway, Suite 1015, Oakland, CA 94612
10/2000 – 03/2001	Postdoctoral Fellow Department of Geology & Geophysics University of Wisconsin at Madison 1215 W. Dayton Street, Madison, WI53706
10/1999 – 09/2000	Postdoctoral Associate Department of Civil & Environmental Engineering, MIT 15 Vassar Street, Cambridge, MA 02139
10/1995 – 10/1996	Senior Engineer
07/1990 – 10/1995	Engineer Nanjing Institute of Hydrology and Water Resources Ministry of Water Resources, Nanjing, China

3. RESEARCH INTERESTS

- Analytical and numerical modeling of fluid flow and heat/solute transport in fractured/porous media for geological carbon storage, geothermal energy production, nuclear waste disposal, and contamination remediation
- Multiphase and unsaturated flow in heterogeneous fractured/porous media: preferential flow and fracture-matrix interactions
- Theoretical studies and field evidence of thermal fracturing at CO₂ storage sites and in enhanced geothermal systems (EGS)
- Geological carbon storage: fundamental and dynamic processes of CO₂ flow channeling, invasion, spreading, and breakthrough (CISB) at laboratory and field scale; CO₂ plume migration and enhanced storage in heterogeneous and fractured rocks; pressure buildup and brine migration and their impact on groundwater resources at basin scale; early leakage detection via joint inversion

- Diffusive transport in fractured rock and layered porous media: fundamental diffusive flux equation and memory functions; coupling of hydraulic, solute, or thermal diffusion with advection and dispersion in fractures or high-permeability channels; field-scale effective diffusion in heterogeneous media
- Field flow and transport processes with enhanced understanding: data integration and analysis, forward modeling, and joint inversion for several field projects of geological carbon storage; analysis of field tracer tests; large-scale contaminant plumes with physical, chemical, microbial (biodegradation) processes
- Density-dependent flow for seawater intrusion and convective dissolved CO₂ transport

4. AWARDS AND PROFESSIONAL SOCIETIES

- “Director’s Award for Exceptional Achievement,” Lawrence Berkeley National Laboratory, 2012
- “Outstanding Performance Award,” Lawrence Berkeley National Laboratory, 2007
- “The Miriam and Aaron Gutwirth Award,” the Gutwirth Foundation, Israel, 1999
- “The Irmay Prize,” Dept. of Civil Engineering, Technion-Israel Institute of Technology, Israel, 1998
- Supervisor of three postdoctoral fellows, two project scientists, and five visiting PhD students/scholars
- An international member of the Steering Committee of the CO₂CARE (CO₂ Site Closure Assessment Research) Consortium of multiple institutions in EU; A member representing LBNL, a partner of the board of associated parties (BAP) of the PANACEA consortium and MUSTANG consortium in EU.
- Keynote Speech on “Multiple Flow Paths of CO₂ Migration Revealed from Field Monitoring of Frio I Pilot Test and Cranfield Large-Scale Demonstration Project: Potential Applications of Stochastic Joint Inversion”, at the EU-FP7 Funded PANACEA Consortium Meeting, March 31st -- April 1st, 2014, Trondheim, Norway
- Chaired sessions in the Stanford Geothermal Workshops in 2017 and 2018
- Member, American Geophysical Union, Geological Society of America
- Reviewers for top journals in hydrogeology (e.g., *Water Resources Research*, *Advances in Water Resources*), one book chapter (AGU Monograph book chapter), and one book “Geological Storage of CO₂: Modeling Approaches for Large-Scale Simulation” by Jan M. Nordbotten and Michael A. Celia

5. PEER-REVIEWED JOURNAL PUBLICATIONS [Total SCI Citations: 2228, h-Index = 26]

- J72. **Zhou, Q.**, & Chen, B. (2021). Evidence and behavior of thermal fracturing of CO₂ storage complexes in the field. *Proceedings of the National Academy of Sciences of the United States of America* (to be submitted)
- J71. **Zhou, Q.**, Vasco, D. W., Bissel, R., Ringrose, P. S., & Foxall, W. (2021). Dynamic processes of CO₂ storage in the field: 3. Thermal breakdown, caprock fracturing, and CO₂ flow channeling and storage in the fractured reservoir at In Salah, Algeria. *Water Resources Research* (to be submitted)
- J70. **Zhou, Q.**, Li, C., Li, Y., Zhang, K., & Wang, Y. (2021). Dynamic processes of CO₂ storage in the field: 2. Thermal fracturing and self-propping induced by liquid CO₂ injection into the multilayered reservoirs at Ordos, China. *Water Resources Research* (under revision)
- J69. Chang, C., Kneafsey, T. J., & **Zhou, Q.** (2021). Core-flooding experiments on three-dimensional CO₂-water drainage and fracture-matrix interactions in fractured porous media. *Advances in Water Resources* (submitted).
- J68. Zhang, Q., Oldenburg, C. M., **Zhou, Q.**, Pan, L., Freifeld, B. M., Jeanne, P. Rodríguez Tribaldos, V., & Vasco, D. W. (2021). Advanced monitoring and simulation for underground gas storage risk management. *Journal of Petroleum Science and Engineering* (submitted)
- J67. Chen, B., & **Zhou, Q.** (2021). Scaling behavior of thermally driven fractures in deep low-permeability reservoirs: 4. Axisymmetric strain model with heat convection and conduction. *Journal of Geophysical Research - Solid Earth* (to be submitted).
- J66. Chen, B., & **Zhou, Q.** (2021). Scaling behavior of thermally driven fractures in deep low-permeability reservoirs: 3. Plane strain model with radial heat conduction. *Journal of Geophysical Research - Solid Earth* (to be submitted).

- J65. Chen, B., & **Zhou, Q.** (2021). Scaling behavior of thermally driven fractures in deep low-permeability reservoirs: 2. Axisymmetric strain model with radial heat conduction. *Journal of Geophysical Research - Solid Earth* (to be submitted). PDF
- J64. Chen, B., & **Zhou, Q.** (2021). Scaling behavior of thermally driven fractures in deep low-permeability reservoirs: 1. Plane strain model with heat conduction. *Journal of Geophysical Research - Solid Earth*, 126, 2020JB021582 (under revision). PDF
- J63. Chen, B., & **Zhou, Q.** (2021). Propagation, arrest, and reactivation of thermally driven fractures in an unconfined half-space using stability analysis. *Theoretical and Applied Fracture Mechanics* 113, 102969, <https://doi.org/10.1016/j.tafmec.2021.102969>. [SCI Citations: 0]. PDF
- J62. Appriou, D., Bonneville, A., **Zhou, Q.**, & Gasperikova, E. (2020). Time-lapse gravity monitoring of CO₂ migration based on numerical modeling of a faulted storage complex. *International Journal of Greenhouse Gas Control*, 95, 102956. <https://doi.org/10.1016/j.ijggc.2020.102956>. [SCI Citations: 2]. PDF
- J61. **Zhou, Q.**, Yang, X., Zhang, R., Hosseini, S. A., Ajo-Franklin, J. B., Freifeld, B. M., Daley, T. M., & Hovorka, S. D. (2020). Dynamic processes of CO₂ storage in the field: 1. Multiscale and multipath channeling of CO₂ flow in the hierarchical fluvial reservoir at Cranfield, Mississippi. *Water Resources Research*, 56, e2019EF001360. <https://doi.org/10.1029/2019WR025688>. [SCI Citations: 2]. PDF
- J60. Chang, C., Kneafsey, T. J., **Zhou, Q.**, Oostrom, M., & Ju, Y. (2019). Scaling the impacts of pore-scale characteristics on unstable supercritical CO₂-water drainage using a complete capillary number. *International Journal of Greenhouse Gas Control*, 86, 11-21. <https://doi.org/10.1016/j.ijggc.2019.04.010>. [SCI Citations: 6]. PDF
- J59. González-Nicolás, A., Cihan, A., Petrusak, R., **Zhou, Q.**, Trautz, R., Riestenberg, D., Godec, M., & Birkholzer, J. T. (2019). Pressure management via brine extraction in geological CO₂ storage: adaptive optimization strategies under poorly characterized reservoir conditions. *International Journal of Greenhouse Gas Control*, 83, 176-185. <https://doi.org/10.1016/j.ijggc.2019.02.009>. [SCI Citations: 6]. PDF
- J58. Oldenburg, C. M., Pan, L., **Zhou, Q.**, Dobeck, L., & Spangler, L. (2019). On producing CO₂ from subsurface reservoirs: Simulations of decompression cooling and phase change. *Greenhouse Gases: Science and Technology*, 9, 194–208. <https://doi.org/10.1002/ghg.1852>. [SCI Citations: 2]. PDF
- J57. **Zhou, Q.**, Oldenburg, C. M., & Rutqvist, J. (2019). Revisiting the analytical solutions of heat transport in fractured reservoirs using a generalized multirate memory function. *Water Resources Research*, 55, 1405–1428. <https://doi.org/10.1029/2018WR024150>. [SCI Citations: 7]. PDF
- J56. Onishi, T., Nguyen, M. C., Carey, J. W., Will, R., Zaluski, W., Bowen, D. W., Devault, C., Duguid, A., **Zhou, Q.**, Fairweather, S. H., Spangler, L. H., & Stauffer, P. H. (2019). Potential CO₂ and brine leakage through wellbore pathways for geologic CO₂ sequestration using the National Risk Assessment Partnership tools: Application to the Big Sky Regional Partnership. *International Journal of Greenhouse Gas Control*, 81, 44-65. <https://doi.org/10.1016/j.ijggc.2018.12.002>. [SCI Citations: 9]. PDF
- J55. Chang, C., **Zhou, Q.**, Kneafsey, T. J., Oostrom, M., & Ju, Y. (2019). Coupled supercritical CO₂ dissolution and water flow in pore-scale micromodels. *Advances in Water Resources*, 123, 54–69. <https://doi.org/10.1016/j.advwatres.2018.11.004>. [SCI Citations: 3]. PDF
- J54. **Zhou, Q.**, Oldenburg, C. M., Rutqvist, J., & Birkholzer, J. T. (2017). Revisiting the fundamental analytical solutions of heat and mass transfer: The kernel of multirate and multidimensional diffusion. *Water Resources Research*, 53, 9960–9979, <https://doi.org/10.1002/2017WR021040>. [SCI Citations: 3]. [PDF](#)
- J53. Jeanne, P., Rutqvist, J., Wainwright, H. M., Rinaldi, A. P., Foxall, W., **Zhou, Q.**, Birkholzer, J. T., & Layland-Bachmann, C. (2017). Effects of the distribution and evolution of the coefficient of friction along a fault on the assessment of the seismic activity associated with a hypothetical industrial-scale geologic CO₂ sequestration operation. *International Journal of Greenhouse Gas Control* 66, 254-263, <https://doi.org/10.1016/j.ijggc.2017.09.018>. [SCI Citations: 1]. [PDF](#)
- J52. Chang, C., Ju, Y., Xie, H., **Zhou, Q.**, & Gao, F. (2017). Non-Darcy interfacial dynamics of air-water two-phase flow in rough fractures under drainage conditions. *Scientific Report*, 7: 4570 | <https://doi.org/10.1038/s41598-017-04819-x>. [SCI Citations: 5]. [PDF](#)
- J51. Agartan, E., Cihan, A., Illangasekare, T. H., **Zhou, Q.**, & Birkholzer, J. T. (2017). Mixing and trapping of dissolved CO₂ in deep geologic formations with shale layers. *Advances in Water Resources*, 105, 67–81, <https://doi.org/10.1016/j.advwatres.2017.04.014>. [SCI Citations: 6]. [PDF](#)

- J50. Chang, C., **Zhou, Q.**, Oostroom, M., Kneafsey, T. J., & Mehta, H. (2017). Pore-scale supercritical CO₂ dissolution and mass transfer under drainage conditions. *Advances in Water Resources*, 100, 14–25, <https://doi.org/10.1016/j.advwatres.2016.12.003>. [SCI Citations: 13]. [PDF](#)
- J49. **Zhou, Q.**, Oldenburg, C. M., Spangler, L.H., & Birkholzer, J. T. (2017). Approximate solutions for diffusive fracture-matrix transfer: Application to storage of dissolved CO₂ in fractured rocks. *Water Resources Research*, 53(2), 1746–1762, <https://doi.org/10.1002/2016WR019868>. [SCI Citations: 11]. [PDF](#)
- J48. Trevisan, L., Pini, R., Cihan, A., Birkholzer, J. T., **Zhou, Q.**, Gonzalez-Nicolas, A., & Illangasekare, T. H. (2017). Imaging and quantification of spreading and trapping of carbon dioxide in saline aquifers using meter-scale laboratory experiments. *Water Resources Research*, 53(1), 485–502, <https://doi.org/10.1002/2016WR019749>. [SCI Citations: 21]. [PDF](#)
- J47. Jeanne, P., Rutqvist, J., Wainwright, H. M., Foxall, W., Bachmann, C., **Zhou, Q.**, Rinaldi, A. P., & Birkholzer, J. T. (2016). Effects of in situ stress measurement uncertainties on assessment of predicted seismic activity and risk associated with a hypothetical industrial-scale geologic CO₂ sequestration operation. *Journal of Rock Mechanics and Geotechnical Engineering*, 8(6), 873–885, <https://doi.org/10.1016/j.jrmge.2016.06.008>. [SCI Citations: 2]. [PDF](#)
- J46. Oldenburg, C. M., Cihan, A., **Zhou, Q.**, Fairweather, S., & Spangler, L. H. (2016). Geologic carbon sequestration injection wells in over-pressured storage reservoirs: Estimating area of review. *Greenhouse Gases: Science and Technology*, 6(6): 775–786, <https://doi.org/10.1002/ghg.1607>. [SCI Citations: 2]. [PDF](#)
- J45. Tian, L., Yang, Z., Jung, B., Joodaki, S., Erlström, M., **Zhou, Q.**, & Niemi, A. (2016). Integrated simulations of CO₂ spreading and pressure response of Southwest Scania Site, Sweden. *Greenhouse Gases: Science and Technology*, 6(4): 531–545, <https://doi.org/10.1002/ghg.1583>. [SCI Citations: 4]. [PDF](#)
- J44. Chang, C., **Zhou, Q.**, Kneafsey, T. J., Oostroom, M., Wietsma, T. W., & Yu, Q. (2016). Pore-scale supercritical CO₂ dissolution and mass transfer under imbibition conditions. *Advances in Water Resources* 92, 142–158, <https://doi.org/10.1016/j.advwatres.2016.03.015>. [SCI Citations: 22]. [PDF](#)
- J43. Wang, Y., Hu, M., **Zhou, Q.**, & Rutqvist, J. (2016). A new second-order numerical manifold method model with an efficient scheme for analyzing free surface flow with inner drains. *Applied Mathematical Modeling*, 40, 1427–1445, <https://doi.org/10.1016/j.apm.2015.08.002>. [SCI Citations: 19]. [PDF](#)
- J42. Trevisan, L., Pini, R., Cihan, A., Birkholzer, J. T., **Zhou, Q.**, & Illangasekare, T. H. (2015). Experimental analysis of spatial correlation effects on capillary trapping of supercritical CO₂ at the intermediate laboratory scale in heterogeneous porous media. *Water Resources Research*, 51, 8791–8805, <https://doi.org/10.1002/2015WR017440>. [SCI Citations: 31]. [PDF](#)
- J41. Jung, Y., **Zhou, Q.**, & Birkholzer, J. T. (2015). On the detection of leakage pathways in geological CO₂ storage systems using pressure monitoring data: Impact of model parameter uncertainties. *Advances in Water Resources*, 84, 112–124, <https://doi.org/10.1016/j.advwatres.2015.08.005>. [SCI Citations: 9]. [PDF](#)
- J40. Birkholzer, J. T., Oldenburg, C. M., & **Zhou, Q.** (2015). CO₂ migration and pressure evolution in deep saline aquifers. *International Journal of Greenhouse Gas Control*, 40, 203–220, <https://doi.org/10.1016/j.ijggc.2015.03.022>. [SCI Citations: 57]. [PDF](#)
- J39. Agartan, E., Trevisan, L., Cihan, A., Birkholzer, J., **Zhou, Q.**, & Illangasekare, T. H. (2015). Experimental study on effects of geologic heterogeneity in enhancing dissolution trapping of supercritical CO₂. *Water Resources Research*, 51, 1635–1648. <https://doi.org/10.1002/2014WR015778>. [SCI Citations: 50]. [PDF](#)
- J38. Wang, Y., Hu, M., **Zhou, Q.**, & Rutqvist, J. (2014). Energy-work-based numerical manifold seepage analysis with an efficient scheme to locate the phreatic surface. *International Journal for Numerical and Analytical Methods in Geomechanics*, 38, 1633–1650. <https://doi.org/10.1002/nag.2280>. [SCI Citations: 26]. [PDF](#)
- J37. Trevisan, L., Cihan, A., Agartan, E., Mori, H., Fagerlund, F., Birkholzer, J. T., **Zhou, Q.**, & Illangasekare, T. H. (2014). Investigation of mechanisms of supercritical CO₂ trapping in deep saline reservoirs using surrogate fluids at ambient laboratory conditions. *International Journal of Greenhouse Gas Control* 29, 35–49. <https://doi.org/10.1016/j.ijggc.2014.07.012>. [SCI Citations: 25]. [PDF](#)
- J36. Chang, C., **Zhou, Q.**, Guo, J., & Yu, Q. (2014). Supercritical CO₂ dissolution and mass transfer in low-permeability sandstone: Effect of concentration difference in water-flood experiments. *International Journal of Greenhouse Gas Control* 28, 328–342. <https://doi.org/10.1016/j.ijggc.2014.07.006>. [SCI Citations: 21]. [PDF](#)

- J35. Wainwright, H. M., Finsterle, S., Jung, Y., **Zhou, Q.**, & Birkholzer, J. T. (2014). Making sense of global sensitivity analysis. *Computers & Geoscience*, 65, 84-94. [https://doi.org/ 10.1016/j.cageo.2013.06.006](https://doi.org/10.1016/j.cageo.2013.06.006). [SCI Citations: 93]. [PDF](#)
- J34. Cihan, A., **Zhou, Q.**, Birkholzer, J. T., Kraemer, S.R. (2014). Flow in horizontally anisotropic multilayered aquifer systems with leaky wells and aquitards. *Water Resources Research*, 50, 741-747. [https://doi.org/ 10.1002/2013WR013867](https://doi.org/10.1002/2013WR013867). [SCI Citations: 10]. [PDF](#)
- J33. Cihan, A., Birkholzer, J. T., Illangasekare, T. H., & **Zhou, Q.** (2014). A modeling approach to represent hysteresis in capillary pressure-saturation relationship based on fluid connectivity in void space. *Water Resources Research*, 50, 119-131. [https://doi.org/ 10.1002/2013WR014280](https://doi.org/10.1002/2013WR014280). [SCI Citations: 11]. [PDF](#)
- J32. Liu, X., **Zhou, Q.**, Kitanidis, P. K., Birkholzer, J. T. (2014). Fast iterative implementation of large-scale nonlinear geostatistical inverse modeling. *Water Resources Research*, 50, 198-207. [https://doi.org/ 10.1002/2012WR013241](https://doi.org/10.1002/2012WR013241). [SCI Citations: 12]. [PDF](#)
- J31. Chen, F., Wiese, B., **Zhou, Q.**, Kowalsky, M. B., Norden, B., Kempka, T., & Birkholzer, J. T. (2014). Numerical modeling of the pumping tests at the CO₂ pilot site in Ketzin, Germany: Model calibration and heterogeneity effects. *International Journal of Greenhouse Gas Control*, 22, 200-2012. [https://doi.org/ 10.1016/j.ijggc.2014.01.003](https://doi.org/10.1016/j.ijggc.2014.01.003). [SCI Citations: 12]. [PDF](#)
- J30. Jung, Y., **Zhou, Q.**, & Birkholzer, J. T. (2013). Early detection of brine and CO₂ leakage through abandoned wells using pressure and surface-deformation monitoring data: Concept and demonstration. *Advances in Water Resources*, 62, 555-569. <https://doi.org/10.1016/j.advwatres.2013.06.008>. [SCI Citations: 43]. [PDF](#)
- J29. Liu, X., **Zhou, Q.**, Birkholzer, J. T. & Illman, W. A. (2013). Geostatistical reduced-order models in under-determined inverse problems. *Water Resources Research*, 49(10), 6587-6600. <https://doi.org/10.1002/wrcr.20489>. [SCI Citations: 18]. [PDF](#)
- J28. Birkholzer, J. T., Nicot, J.-P., Oldenburg, C. M., **Zhou, Q.**, Kraemer, S., & Bandilla, K. (2013). Reply to comments by Schnaar et al. on “Brine flow up a well caused by pressure perturbation from geologic carbon sequestration: static and dynamic Evaluations” by Birkholzer et al. (2011). *International Journal of Greenhouse Gas Control*, 17, 544-545. [https://doi.org/ 10.1016/j.ijggc.2013.06.001](https://doi.org/10.1016/j.ijggc.2013.06.001).
- J27. Wainwright, H., Finsterle, S., **Zhou, Q.**, & Birkholzer, J. T. (2013). Modeling the performance of large-scale CO₂ storage systems: A comparison of different sensitivity analysis methods. *International Journal of Greenhouse Gas Control*, 17, 189-205. [https://doi.org/ 10.1016/j.ijggc.2013.05.007](https://doi.org/10.1016/j.ijggc.2013.05.007). [SCI Citations: 51]. [PDF](#)
- J26. Chang, C., **Zhou, Q.**, Xia, L., Li, X., & Yu, Q. (2013). Dynamic displacement and non-equilibrium dissolution of supercritical CO₂ in low-permeability sandstone: An experimental study. *International Journal of Greenhouse Gas Control*, 14, 1-14. [https://doi.org/ 10.1016/j.ijggc.2012.12.025](https://doi.org/10.1016/j.ijggc.2012.12.025). [SCI Citations: 56]. [PDF](#)
- J25. Cihan, A., Birkholzer, J. T., & **Zhou, Q.** (2013). Pressure buildup and brine migration in CO₂ storage systems with multiple leakage pathways: Application of a new analytical solution. *Ground Water*, 51(2), 252-267. [https://doi.org/ 10.1111/j.1745-6584.2012.00972.x](https://doi.org/10.1111/j.1745-6584.2012.00972.x). [SCI Citations: 52]. [PDF](#)
- J24. Birkholzer, J. T., Cihan, A., & **Zhou, Q.** (2012). Impact-driven pressure management via targeted brine extraction – Conceptual studies of CO₂ storage in saline formations. *International Journal of Greenhouse Gas Control*, 7, 168-180. <https://doi.org/10.1016/j.ijggc.2012.01.001>. [SCI Citations: 82]. [PDF](#)
- J23. Cihan, A., **Zhou, Q.**, & Birkholzer, J. T. (2011). Analytical solutions for pressure perturbation and fluid leakage through aquitards and wells in multilayered-aquifer systems. *Water Resources Research*, 47, W10504. <https://doi.org/10.1029/2011WR010721>. [SCI Citations: 52]. [PDF](#)
- J22. Birkholzer, J. T., Nicot, J.-P., Oldenburg, C. M., **Zhou, Q.**, Kraemer, S., & Bandilla, K. (2011). Brine flow up a well caused by pressure perturbation from geologic carbon sequestration: Static and dynamic evaluations. *International Journal of Greenhouse Gas Control*, 5(4), 850-861. <https://doi.org/10.1016/j.ijggc.2011.01.003>. [SCI Citations: 59]. [PDF](#)
- J21. **Zhou, Q.**, & Birkholzer, J. T. (2011). On scale and magnitude of pressure build-up induced by large-scale geologic storage of CO₂. *Greenhouse Gases: Science and Technology*, 1, 11-20. [https://doi.org/ 10.1002/ghg3.001](https://doi.org/10.1002/ghg3.001). [SCI Citations: 56]. [PDF](#)
- J20. **Zhou, Q.**, Birkholzer, J. T., & Tsang, C.-F. (2011). Reply to Comments by Veling on “A Semi-Analytical Solution for Large-Scale Injection-Induced Pressure Perturbation and Leakage in a Laterally Bounded Aquifer-Aquitard System” by Zhou, Birkholzer, and Tsang. *Transport in Porous Media*, 86, 357-358. <https://doi.org/10.1007/s11242-008-9290-0>. [PDF](#)

- J19. **Zhou, Q.**, Birkholzer, J. T., Mehnert, E., Lin, Y.-F., & Zhang, K. (2010). Modeling basin- and plume-scale processes of CO₂ storage for full-scale deployment. *Ground Water*, 48(4), 494-514. <https://doi.org/10.1111/j.1745-6584.2009.00657.x>. [SCI Citations: 131]. [PDF](#)
- J18. Birkholzer, J. T., & **Zhou, Q.** (2009). Basin-scale hydrogeologic impacts of CO₂ storage: Regulatory and capacity implications. *International Journal of Greenhouse Gas Control*, 3(6), 745–756. <https://doi.org/10.1016/j.ijggc.2009.07.002>. [SCI Citations: 162]. [PDF](#)
- J17. **Zhou, Q.**, McCraven, S., Garcia, J., Gasca, M., Johnson, T. A., & Motzer, W. (2009). Field evidence of biodegradation of N-Nitrosodimethylamine (NDMA) in groundwater with incidental and active recycled water recharge. *Water Research*, 43(3), 793-805. <https://doi.org/10.1016/j.watres.2008.11.011>. [SCI Citations: 36]. [PDF](#)
- J16. **Zhou, Q.**, Birkholzer, J. T., & Tsang, C.-F. (2009). A semi-analytical solution for large-scale injection-induced pressure perturbation and leakage in a laterally bounded aquifer-aquitard system. *Transport in Porous Media*, 78(1), 127-148, <https://doi.org/10.1007/s11242-008-9290-0>. [SCI Citations: 35]. [PDF](#)
- J15. Birkholzer, J. T., **Zhou, Q.**, & Tsang, C.-F. (2009). Large-scale impact of CO₂ storage in deep saline aquifers: A sensitivity study on pressure response in stratified systems. *International Journal of Greenhouse Gas Control* 3, 181-194. <https://doi.org/10.1016/j.ijggc.2008.08.002>. [SCI Citations: 318]. [PDF](#)
- J14. **Zhou, Q.**, Birkholzer, J. T., Tsang, C.-F., & Rutqvist, J. (2008). A method for quick assessment of CO₂ storage capacity in closed and semi-closed saline aquifers. *International Journal of Greenhouse Gas Control*, 2, 626-639. <https://doi.org/10.1016/j.ijggc.2008.02.004>. [SCI Citations: 246]. [PDF](#)
- J13. Guan, J., Molz, F. J., **Zhou, Q.**, Liu, H.-H., & Zheng, C. (2008). Behavior of the mass transfer coefficient during the MADE-2 experiment: New insights. *Water Resources Research*, 44, W02423. <https://doi.org/10.1029/2007WR006120>. [SCI Citations: 27]. [PDF](#)
- J12. Su, G. W., Jasperse, J., Seymour, D., Constantz, J., & **Zhou, Q.** (2007). Simulation analysis of pumping-induced unsaturated regions beneath a perennial river. *Water Resources Research*, 43, W08421. <https://doi.org/10.1029/2006WR005389>. [SCI Citations: 26]. [PDF](#)
- J11. **Zhou, Q.**, Liu, H.-H., Molz, F. J., Zhang, Y., & Bodvarsson, G. S. (2007). Field-scale effective matrix diffusion coefficient for fractured rock: Results from literature survey. *Journal of Contaminant Hydrology*, 93, 161–187. <https://doi.org/10.1016/j.jconhyd.2007.02.002>. [SCI Citations: 68]. [PDF](#)
- J10. Liu, H.-H., Zhang, Y., **Zhou, Q.**, & Molz, F. J. (2007). An interpretation of potential scale dependence of the effective matrix diffusion coefficient. *Journal of Contaminant Hydrology*, 90, 41-57. <https://doi.org/10.1016/j.jconhyd.2006.09.006>. [SCI Citations: 33]. [PDF](#)
- J09. Zhang, Y., Liu, H.-H., **Zhou, Q.**, & Finsterle, S. (2006). Effects of diffusive property heterogeneity on effective matrix diffusion coefficient for fractured rock. *Water Resources Research*, 42, W04405. <https://doi.org/10.1029/2005WR004513>. [SCI Citations: 15]. [PDF](#)
- J08. **Zhou, Q.**, Liu, H.-H., Bodvarsson, G. S., & Molz, F. J. (2006a). Evidence of multi-process matrix diffusion in a single fracture from a field tracer test. *Transport in Porous Media*, 63(3), 473–487. <https://doi.org/10.1007/s11242-005-1123-9>. [SCI Citations: 27]. [PDF](#)
- J07. **Zhou, Q.**, Salve, R., Liu, H.-H., Wang, J., & Hudson, D. (2006b). Analysis of a meso-scale infiltration and water seepage test in unsaturated fractured rock: Spatial variabilities and discrete fracture patterns. *Journal of Contaminant Hydrology*, 87, 96-122. <https://doi.org/10.1016/j.jconhyd.2006.05.001>. [SCI Citations: 13]. [PDF](#)
- J06. **Zhou, Q.**, Bear, J., & Bensabat, J. (2005). Saltwater upconing and decay beneath a well pumping above an interface zone. *Transport in Porous Media*, 61(3), 337-363. <https://doi.org/10.1007/s11242-005-0261-4>. [SCI Citations: 35]. [PDF](#)
- J05. **Zhou, Q.**, Birkholzer, J. T., Javandel, I., & Jordan, P. D. (2004). Modeling three-dimensional groundwater flow and advective contaminant transport at a heterogeneous mountainous site in support of remediation. *Vadose Zone Journal*, 3, 884–900. <https://doi.org/10.2113/3.3.884>. [SCI Citations: 3]. [PDF](#)
- J04. **Zhou, Q.**, Liu, H.-H., Bodvarsson, G. S., & Oldenburg, C. M. (2003). Flow and transport in unsaturated fractured rocks: Effects of multiscale heterogeneity of hydrogeologic properties. *Journal of Contaminant Hydrology*, 60 (1-2), 1-30. [https://doi.org/10.1016/S0169-7722\(02\)00080-3](https://doi.org/10.1016/S0169-7722(02)00080-3). [SCI Citations: 34]. [PDF](#)
- J03. **Zhou, Q.**, Bensabat, J., & Bear, J. (2001). Accurate calculation of specific discharge in heterogeneous porous media. *Water Resources Research*, 37(12), 3057-3069. <https://doi.org/10.1029/1998WR900105>. [SCI Citations: 17]. [PDF](#)

- J02. Bensabat, J., **Zhou, Q.**, & Bear, J. (2000). An adaptive pathline-based particle tracking algorithm for the Eulerian-Lagrangian method. *Advances in Water Resources*, 23(4), 383-397. [https://doi.org/10.1016/S0309-1708\(99\)00025-1](https://doi.org/10.1016/S0309-1708(99)00025-1). [SCI Citations: 30]. [PDF](#)
- J01. Zhu, Y., & **Zhou, Q.** (1995). Risk analysis of flood control benefits of the Three-Gorge Project. *Journal of Advances in Water Sciences* (in Chinese) 6(1), 29-35.

6. RESEARCH PROPOSALS FUNDED (FY07-FY19, TOTAL FUNDS AS PI AND CO-PI: \$10.179 M)

Ongoing Projects in Geological Carbon Storage and Geothermal Systems

1. Offshore Gulf of Mexico Partnership for carbon capture and storage (FY18-FY22, **Co-PI** with Curt Oldenburg, **\$800K** funded by USDOE)
2. Toward 100 million tons plus: Basin-scale assessments revisited (FY19-FY21, **PI**: Jens Birkholzer, \$1,710K funded by TOTAL)
3. An integrated risk management and decision-support system for ensuring the integrity of underground natural gas storage infrastructure in California (FY17-FY20, **PI**: Yingqi Zhang, \$3,000K funded by CEC)
4. The EGS Collab SIGMA-V Project: Stimulation investigations for geothermal modeling analysis and validation (FY17-FY19, **PI**: Tim Kneafsey, \$9,000K/year funded by USDOE)
5. Comprehensive physical-chemical modeling to reduce risks and costs of flexible geothermal energy production (FY17-FY20, **Co-PI** with Jonny Rutqvist, **\$1,000K** funded by CEC)
6. NRAP Project: Thermal fracturing at two CO₂ storage sites (FY18-FY21, **PI**, **\$366K** funded by DOE)

Completed Projects in Geological Carbon Storage (FY2007 – FY2018)

7. NRAP Project: Fault leakage at the Kimberlina site (FY15-FY18, **PI**, **\$320K** funded by DOE)
8. Multiscale modeling of CO₂ migration and trapping in fractured reservoirs with validation by model comparison and real-site applications (DE-FE-0023323, FY15-FY17, **PI**, LBNL share of **\$200K**, total project \$1,000K led by Prof. Mike Celia at Princeton University, funded by USDOE)
9. Modeling and monitoring support of the Big Sky Partnership's Phase III project at Kevin Dome (FY2011 – FY2018, **Co-PI** with Curtis Oldenburg and Task Lead for modeling, **\$2,671K** funded by USDOE)
10. An Advanced Joint Inversion System for CO₂ Storage Modeling with Large Data Sets for Characterization and Real-Time Monitoring — Enhancing Storage Performance and Reducing Failure Risks under Uncertainties (DE-FE-0009260, FY13-FY15, **PI**, LBNL share of **\$200K**, total project \$1,000K led by Prof. Peter Kitanidis at Stanford University, funded by USDOE)
11. Stochastic Joint Inversion for CO₂ Storage Modeling and Monitoring (FY13-FY15, **PI**, **\$345K** funded by USDOE)
12. Large-scale hydrologic impacts of CO₂ geological storage (FY10 – FY13, **Co-PI** with Jens Birkholzer, **\$1,391K** funded by USDOE) (\$375K in FY10 + \$386K in FY11 + \$380K in FY12 + \$250K in FY13)
13. Joint inversion of monitoring data for early leakage detection (FY10 – FY13, **PI**, **\$2,000K** funded by USDOE)
14. Validation of models simulating capillary and dissolution trapping during injection and post-injection of CO₂ in heterogeneous geological formations using data from intermediate scale test systems (DE-FE-0004630, FY2011 – FY2013, \$600K funded by USDOE, LBNL share of \$150K)
15. Potential impacts of future geological storage of CO₂ on the groundwater resources in California's Central Valley (September 2010 – May 2013, **PI**, **\$490K** funded by California Energy Commission)
16. Collaboration with China on geologic carbon sequestration: Novel field tests to characterize heterogeneity for China's first pilot test (FY2011 – FY2012, **PI**, **\$315K**, LDRD, funded by Lawrence Berkeley National Laboratory)
17. Analytical and numerical modeling in support of EPA Area-of-Review estimates and geologic sequestration modeling framework (2008-2012, **PI**, **\$447.5K** funded by USEPA)
18. Large-scale hydrological evaluation and modeling of the impact of CO₂ geological sequestration on groundwater systems (FY2007-FY2009, **PI**: Jens Birkholzer, \$900K funded by USDOE)