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Education

B.A., 1980, University of Arizona, Anthropology
Thesis: A Use-Wear Analysis of Clovis Points
B.S., 1980, University of Arizona, Geology
M.S., 1982, University of Michigan, Geology
Thesis: Phase Equilibria in the System $\text{CaCO}_3\text{-MgCO}_3\text{-FeCO}_3$
Ph.D., 1987, University of Michigan, Geology
Dissertation: P-T-t Constraints on the Metamorphism of the Grenville Province, Ontario

Academic Honors

University Academic Honors, University of Arizona, 1978
EXXON Corporation Scholarship, University of Arizona, 1979
Wilson R. Thompson Scholarship, University of Arizona, 1979
University Class Scholarship Awards, University of Arizona, 1979, 1980
Phi Beta Kappa, 1979
Phi Kappa Phi, 1979
Graduation with honors and highest distinction, University of Arizona, 1980
Outstanding Senior, College of Earth Sciences, University of Arizona, 1980
Rackham First Year Fellow, University of Michigan, 1980-81
NSF Graduate Fellow, University of Michigan, 1981-84
CONOCO Fellow, University of Michigan, 1982-83
Rackham Predoctoral Fellow, University of Michigan, 1984-85
Research Fellow, University of Michigan, 1985-86
Presidential Young Investigator, 1989-1997
Fellow, Mineralogical Society of America, 2007

Membership in Professional Societies and Professional Service

Mineralogical Society of America, American Geophysical Union, Geochemical Society, European Association of Geochemistry, Sigma Xi
MSA Joint Technical Program Committee for GSA meeting, 1993 – 2001
Associate Editor, *Geochimica et Cosmochimica Acta*, 2012 to present

Professional Experience

EXXON Minerals Co., Tucson, Arizona, 1981
U.S. Geological Survey (with J. Haas), Reston, Virginia, 1982
Assistant Professor, University of Arizona, Department of Geosciences, August 1987-August 1994
Visiting Professor, Oak Ridge National Laboratory ORISE program, June, 1994 - September, 1994
Research Assistant Professor, University of Tennessee, October, 1994 – 2008
Research Associate Professor, University of Tennessee, October, 2008 – August, 2010
Visiting Professor, Oak Ridge National Laboratory, October 1994 – August, 2010
Adjunct Professor, University of Tennessee, August, 2010 – present
Staff Scientist, Oak Ridge National Laboratory August, 2010 – November 2013
Senior Staff Scientist, Oak Ridge national Laboratory, November, 2013 – present
Associate Professor, Bredesen Center, University of Tennessee, August 2015-present

PUBLICATIONS - LAWRENCE MICHAEL ANOVITZ

In Print or In Press

- Smith, B, and Anovitz, LM (2015) Hydrogen Permeability Measurements of Treated Elastomers. ORNL/LTR-2015/256
- Bingham, PR, Polsky, Y, Anovitz, LM, Carmichael, JR, Bilheux, HZ, Hussey, D, and Jacobson, D (2015) Neutron radiography of fluid flow for geothermal energy research. *Physics Procedia* 69, 464-471.
- Brady, MP, Rother, G, Anovitz, LM, Littrell, KC, Unocic, KA, Elsentriecy, HH, Song, GL, Thomson, JK, Gallego, NC and Davis, B (2015) Film Breakdown and Nano-Porous Mg(OH)₂ Formation from Corrosion of Magnesium Alloys in Salt Solutions. *Journal of The Electrochemical Society*, 162 (4) C140-C149.
- Buchwalter, E.; Swift, A.; Cole, D.; Sheets, J.; Prisk, T.; Anovitz, L.; Ilavsky, J.; Rivers, M.; Welch, S.; Bodnyk, K.; Hart, R. (2015) Mapping of Microbial Habitats in Organic-Rich Shale. *URTeC*, 2174226, [[10.15530/urtec-2015-2174226](https://doi.org/10.15530/urtec-2015-2174226)]
- Kolbus, LM, Wang, H-W, Anovitz, LM, Wesolowski, DJ, Whitfield, PS, and Rondinone, AJ (2015) Solvothermal synthesis and coordination chemistry to control the size and morphology of nano-quartz. *Crystal Growth and Design*. Accepted with corrections, resubmitted.
- Steeffel, CI, Emmanuel, S, and Anovitz, LM. (2015) Pore-Scale Geochemical Processes. *Reviews in Mineralogy and Geochemistry*, vol. 80, 481 pp.
- Brady, M.P., Fayek, M., Meyer, H.M. III, Leonard, D.N., Elsentriecy, H.H., Unocic, K.A., Anovitz, L.M., Cakmak, E., Keiser, J.R., Song, G.L., and Davis, B. (2015) Tracer study of oxygen and hydrogen uptake by Mg alloys in air with water vapor. *Scripta Materialia*, 106, 38-41.
- Anovitz, L. M., and Cole, D. R. (2015) Characterization and analysis of porosity and pore structures. *Reviews in Mineralogy and Geochemistry*, 80, 61-164.
- Emmanuel, S.; Anovitz, L. M.; Day-Stirrat, R. J. (2015) Effects of Coupled Chemo-Mechanical Processes on the Evolution of Pore-Size Distributions in Geological Media. *Rev. Mineral. Geochem.*, 80, 45-60.
- Buchwalter, E.; Swift, A.; Cole, D.; Sheets, J.; Prisk, T.; Anovitz, L.; Ilavsky, J.; Rivers, M.; Welch, S.; Bodnyk, K.; Hart, R. (2015) Mapping of Microbial Habitats in Organic-Rich Shale. *URTeC*, 2174226, [[10.15530/urtec-2015-2174226](https://doi.org/10.15530/urtec-2015-2174226)]
- Anovitz, L. M.; Cole, D. R.; Sheets, J.; Swift, J.; Elston, H. W.; Welch, S.; Chipera, S. J.; Littrell, K. C.; Mildner, D.F.R.; Wasbrough, M. J. (2015) Effects of maturation on multiscale (nanometer to millimeter) porosity in the Eagle Ford Shale. *Interpretation* 3, 1-11. [[10.1190/INT-2014-0280.1](https://doi.org/10.1190/INT-2014-0280.1)]
- Anovitz, LM, Cole, DR, Jackson, AJ, Rother, G, Littrell, K, Allard, LF, Pollington, AD, and Wesolowski, DJ (2015) Effect of quartz overgrowth precipitation on the multiscale porosity of sandstone: A (U)SANS and imaging analysis. *Geochimica et Cosmochimica Acta*, 158, 199-222.
- Deangelis, MT, Labotka, TC, Fayek, M, Cole, DR and Anovitz, LM (in sub). Oxygen diffusion and exchange in dolomite rock at 700°C, 100 MPa. *American Mineralogist* (accepted with revisions).
- Anovitz, LM and Smith, B (2014) Lifecycle Verification of Tank Polymer Liners. ORNL Report. ORNL/TM-2014/48.
- Rother, G., Vlcek, L., Gruszkiewicz, MS, Chialvo, AA, Anovitz, LM, Bañuelos, JL, Wallacher, D, Grimm, N, and Cole, DR (2014) Sorption phase of supercritical CO₂ in aerogel: experiments and mesoscale computer simulations. *Journal of Physical Chemistry C*, 118, 15525-15533.
- Swift, A, Sheets, J, Cole, DR, Anovitz, LM, Welch, S, Gu, X, Mildner, D, Chipera, S, Buchwalter, E,

and Cook, A (2014) Unconventional Resources Technology Conference. In press.

- Anovitz, LM, Cole, DR, Swift, A, Sheets, J, Elston, H, Welch, S, Chipera, SJ, Littrell, KC, Mildner, DFR, and Wasbrough, MJ (2014) Multiscale (nano to mm) porosity in the Eagle Ford Shale: Changes as a function of maturity. Unconventional Resources Technology Conference Proceedings (reviewed publication), AAPG Publication URTeC: 1923519.
- Kolesnikov, AI, Anovitz, LM, Mamontov, E, Podlesnyak, AA, and Ehlers, G (2014) Strong anisotropic dynamics of ultra-confined water. *Journal of Physical Chemistry B*. 47, 13414,13419.
- Brady, MP, Fayek, M, Elsentriecy, HH, Unocic, KA, Anovitz, LM, Keiser, JR, Song, G, Davis, B (2014) Tracer film study of hydrogen and oxygen uptake from the corrosion reaction of magnesium in water. *Journal of the Electrochemical Society*, 161 (9), C295-C404.
- Stack, AG.; Fernandez-Martinez, A; Allard, LF, Bañuelos, JL, Rother, G, Anovitz, LM, Cole, DR, and Waychunas, GA (2014) Pore-Size-Dependent Calcium Carbonate Precipitation Controlled by Surface Chemistry. *Environmental Science & Technology* 48, 11, 6177-6183.
- Polsky, Y., Dessieux, L., An, K., Anovitz, L., Bingham, P. and Carmichael, J. (2014) Processing of Neutron Diffraction Data for Strain Measurement in Geological Materials. American Rock Mechanics Association, ARMA 14-7130.
- Swift, A, Anovitz, LM, Sheets, JM, Cole, DR, Welch, SA, Rother, G (2014) Relationship between Mineralogy and Porosity in Caprocks Relevant to Geologic CO₂ Sequestration. *Environmental Geosciences*, 21(2), 39-57.
- Wang, H-W, Anovitz, LM. Burg, A, Cole, DJ, Allard, LF, Jackson, AJ, Stack, AG, and Rother, G (2013) Multi-scale characterization of pore evolution in a combustion metamorphic complex, Hatrurium basin, Israel: Combining (ultra) small-angle neutron scattering and image analysis. *Geochimica et Cosmochimica Acta*, 121, 339-362.
- Anovitz, LM. Mamontov, E., Ishai, PB, and Kolesnikov, AI (2013) Anisotropic dynamics of water ultra-confined in macroscopically oriented channels of single-crystal beryl: A multi-frequency analysis. *Phys. Rev. E*, 88(5), 052306.
- Bingham, P, Polsky, Y, and Anovitz, LM (2013) Neutron imaging for geothermal energy systems. Proceedings of the Imaging Science and Tecnology/SPIE Conference.
- Polsky, Y., Dessieux, L., An, K., Anovitz, L., Bingham, P. and Carmichael, J. (2013) Development of a Neutron Diffraction-Based Strain Measurement Capability for Triaxial Loading Conditions. American Rock Mechanics Association, ARMA 13-249
- Polsky, Y, An, K, Dessieux, L, Anovitz, LM, Bingham, P, Carmichael, J (2013) Development of a Neutron Diffraction Based Experiemental Capability for Investigating Hydraulic Fracturing for EGS-like Conditions. Proc. 38th Workshop On Geothermal Res. Eng., SPG-TR-198.
- Polsky, Y, An, K, Anovitz, LM, Bingham, P, Carmichael, J (2013) Application of Neutron Imaging to Investigate Flow Through Fractures for EGS. Proc. 38th Workshop On Geothermal Res. Eng., SPG-TR-198.
- Anovitz, LM, Wang, H-W, Cole, DR, Sheets, J, Rother, G, Faulder, DD, Walters M (2013) Analysis of Multiscale Porosity at the Coso Geothermal Field. Proc. 38th Workshop On Geothermal Res. Eng., SPG-TR-198.
- Wang, H-W, Wesolowski, DJ, Proffen, T. Vlcek, L, Wang, W, Allard, LF, Kolesnikov, A, Feygenson, M, Anovitz, LM, Paul, R (2013) Structure and Stability of SnO₂ Nanocrystals and Surface-Bound Water Species. *Journal of the American Chemical Society*, 135(18), 6885-6895.
- Anovitz, LM, Cole, DR, Rother, G, Allard, LF JR., Jackson, A, and Littrell, KC (2013) Diagenetic changes in macro-to nano-scale porosity in the St. Peter Sandstone: an (Ultra) small angle neutron scattering and backscattered

electron imaging analysis. *Geochimica et Cosmochimica Acta*, 102, 280-305.

- Haynes, CV Jr., and Anovitz, LM (2012) .50 caliber center fire cartridges of the 1873 Yellowstone Expedition and firearms identification from firing pin and extractor marks. *Journal of the International Ammunition Association*, issue 484, 4-16.
- Carmichael, JR, Rother, G, Browning, J, Ankner, JF, Banuelos, J., Wesolowski, DJ, Anovitz, LM and Cole, DR (2012) High-pressure cell for neutron reflectometry of supercritical and subcritical fluids at solid interfaces. *Review of Scientific Instruments*, 83, 045108.
- Brady, MP, Keiser, JR, More, KL, Fayek, M, Walker, LR, Meisner, RA, Anovitz, LM, Wesolowski, DJ, and Cole, DR (2012) Comparison of short-term oxidation behavior of model and commercial chromia-forming ferritic stainless steels in air with water vapor. *Oxidation of Metals*, 78 (1-2), 1-16.
- Wesolowski, DJ, Sofo, JO, Bandura, AV, Zhang, Z, Mamontov, E, Předota, M, Kumar, N, Kubicki, JD, Kent, PRC, Vlcek, L, Machesky, ML, Fenter, PA, Cummings, PT, Anovitz, LM, Skelton, A, Rosenqvist, J (2011) The Rutile(110)-Water Interface: A comment on “Structure and Dynamics of Liquid Water on Rutile TiO₂(110)” by L.-M. Liu, C. Zhang, G. Thornton and A. Michaelides. *Physical Review B*, 85, 167401.
- Li, S., Banuelos, JL, Guo, J., Anovitz, LM, Rother, G., Shaw, RW, Hillesheim, PC, Dai, S, Baker, GA, and Cummings, PT (2012) Alkyl chain length and temperature effects on structural properties of Pyrrolidinium-based ionic liquids: a combined atomistic simulation and small-angle X-ray scattering study. *J. Phys. Chem. Lett* 3 (1), 125-130.
- Fayek, M., Anovitz, L.M., Allard, LF Jr., and Hull, S. (2012) Framboidal iron oxide: chondrite-like material from the black mat, Murray Springs, Arizona. *Earth and Planetary Sci. Lett*, v. 319-320, 251-258.
- Rother, G., Keiser, JR, Brady, MP, Unocic, KA, Anovitz, LM, Littrell, KC, Peascoe-Meisner, RA, Santella, ML, Wesolowski, DJ, and Cole, DR. (2012) Small-angle neutron scattering study of the wet and dry high-temperature oxidation of alumina- and chromia-forming stainless steels. *Corrosion Science*, 58, 121-132.
- DeAngelis, MT, Rondinone, AJ, Pawel, MD, Labotka, TC and Anovitz, LM (2012) Sol-gel synthesis of nanocrystalline fayalite (Fe₂SiO₄). *American Mineralogist* 97, 653-656.
- Wang, J.-A., Ren, F., Zhang, W., Feng, Z., Anovitz, L., Chen, Z., and Xu, H. (2011) Development of in situ techniques for torsion and tension testing in hydrogen environment. *Proc. of PVP2011, 2011 ASME Pressure Vessels and Piping Division Conf.*, 7 pp.
- McFarlane, J, Qualls, KJ, Qualls, AL, Sabau, AS, Wright, SA, Yin, H, Anovitz, LM, and Kercher, AK (2011) Ways to minimize water usage in engineered geothermal systems. *Groundwater Protection Council Annual Forum*, submitted.
- Kim, M-H, Doh, J-M, Han, SC, Chae, KH, Yu, B-Y, Hong, KT, Jackson, A, and Anovitz, LM (2011) The pore wall structure of porous TiO₂. *J. Applied Crystallography*, 44, 1238-1245.
- Palmer, DA, Benezeth, P, Xiao, CB, Wesolowski, DJ, and Anovitz, LM (2011) Solubility Measurements of Crystalline NiO in Aqueous Solution as a Function of Temperature and pH. *J. Solution Chemistry* 40(4), 680-702.
- Fayek, M., Anovitz, LM, Cole, DR, and Bostick, DA (2011) O and H diffusion in uraninite: implications for fluid-uraninite interactions, nuclear waste disposal, and nuclear forensics. *Geochimica et Cosmochimica Acta*, 75, 3677-3686.
- Anovitz, LM, Rother, G, and Cole, DR. (2011) Characterization of rock pore features in geothermal systems using small angle neutron scattering (SANS). *Proc. 36th Workshop On Geothermal Res. Eng., Sgp-Tr-191*, 571-582.

- Brady, MP, Fayek, M, Keiser, JR, Meyer, HM III, More, KL, Anovitz, LM, Wesolowski, DJ and Cole, DR (2011) Wet oxidation of stainless steels: New insights into hydrogen ingress. *Corrosion Science* 53(5), 1633-1638.
- Otake, T., Wesolowski, D.J., Anovitz, L.M., Allard, L.F., and Ohmoto, H. (2010) Mechanisms of iron oxide transformations in hydrothermal systems. *Geochimica et Cosmochimica Acta* 74(21) 6141-6156.
- Davis MC, Brouwer WJ, Wesolowski DJ, Anovitz LM, Lipton AS, Mueller KT (2009) Magnesium silicate dissolution investigated by ^{29}Si MAS, ^1H - ^{29}Si CPMAS, ^{25}Mg QCPMG, and ^1H - ^{25}Mg CP QCPMG NMR. *Physical Chemistry Chemical Physics* 11, 7013-7021.
- Palmer DA, and Anovitz LM (2009) Solubility of Zinc Silicate and Zinc Ferrite in Aqueous Solution to High Temperatures. *Journal Of Solution Chemistry*, 38, 869-892.
- Palmer DA, Machesky ML, Benezeth P, Wesolowski DJ, Anovitz LM, Deshon JC (2009) Adsorption of Ions on Zirconium Oxide Surfaces from Aqueous Solutions at High Temperatures. *Journal Of Solution Chemistry* 38, 907-924
- Anovitz, L.M., Lynn, G.W., Cole, D.R., Rother, R., Allard, L.F., Hamilton, W.A., Porcar, L., and Kim, M.-H. (2009) A new approach to quantification of metamorphism using ultra-small and small angle neutron scattering. *Geochimica et Cosmochimica Acta*, 73, 7303-7324.
- Mamontov, E., Vlcek, L., Wesolowski, D.J., Cummings, P.T., Rosenqvist, J., Want, W., Cole, D.R., Anovitz, L.M., and Gasparovic, G. (2009) Suppression of the dynamic transition in surface water at low hydration levels: a study of water on rutile. *Phys. Rev. E* 79, 051504.-1 – 051404-6.
- Anovitz, L.M., Cole, D.R., and Riciputi, L.R. (2009) Low-Temperature Isotopic Exchange In Obsidian: Implications for Diffusive Mechanisms. *Geochimica et Cosmochimica Acta* 73, 3795-3806.
- Anovitz, L.M., Cole, D.R. and Fayek, M. (2008) Mechanisms of Rhyolitic Glass Hydration Below the Glass Transition. *Amer. Mineral.* 93(7) 1166-1178.
- Palmer, D.A., Machesky, M.L., Bénézech, P., Wesolowski, D.J., Anovitz, L.M. (2008) Adsorption of ions on zirconium oxide surfaces from aqueous solutions at high temperatures. 15th international Conference on the Properties of Water and Steam.
- Palmer, D.A., Anovitz, L.M. and Wilson, L.L. (2008) Solubility of zinc silicate and zinc ferrite in aqueous solution to high temperatures. 15th international Conference on the Properties of Water and Steam.
- Ziemniak S.E., Anovitz L.M., Castelli R.A., Porter W.D. (2007) Thermodynamics of Cr_2O_3 , FeCr_2O_4 , ZnCr_2O_4 , and CoCr_2O_4 . *Journal Of Chemical Thermodynamics* 39 (11): 1474-1492.
- Vlcek, L., Zhang, Z., Machesky, M.L., Fenter, P., Rosenqvist, J., Wesolowski, D.J., Anovitz, L.M., Predota, M., and Cummings, P.T. (2007) Electric double layer at metal oxide surfaces: static properties of the cassiterite – water interface. *Langmuir* 23 (9), 4925-4937.
- Benezeth, P., Palmer, D.A., Anovitz, L.M. and Horita, J. (2007) Dawsonite synthesis and reevaluation of its thermodynamic properties from solubility measurements: Implications for mineral trapping of CO_2 . *Geochimica et Cosmochimica Acta* 71, 4438-4455.
- Phambu, N., Meya A.S, Djantou, E.B., Phambu, E.N., Phambu, P.K., and Anovitz, L.M. (2007) Direct detection of residual cyanide in cassava using spectroscopic techniques *Journal of Agricultural and Food Chemistry* 55, 10135-10140.
- Otake, T., Wesolowski, D.J., Anovitz, L.M., Allard, L.F. and Ohmoto, H. (2007) Experimental evidence for non-redox

transformations between magnetite and hematite under H₂-rich hydrothermal conditions. *Earth and Planetary Science Letters* 257, 60-70.

- Mamontov, E., Vlcek, L., Wesolowski, D.J., Cummings, P.T., Wang, W., Anovitz, L.M., Rosenqvist, J., Brown, C.M., Garcia Sakai, V. (2007) Dynamics and structure of hydration water on rutile and cassiterite nanopowders studied by quasielastic neutron scattering and molecular dynamics simulations. *J. Phys. Chem. C* 111, 4328-4341.
- DeAngelis, M.T., Labotka, T.C., Cole, D.R., Fayek, M., and Anovitz, L.M. (2007) Experimental investigation of the breakdown of dolomite in rock cores at 100 MPa, 650-750°C. *Amer. Mineral.* 92, 510-517.
- Ziemniak, S.E., Anovitz, L.M., Castelli, R.A. and Porter, W.D. (2006) Magnetic contribution to heat capacity and entropy of nickel ferrite (NiFe₂O₄). *J. Phys. Chem. Solids* 68(1), 10-21.
- Woodward, J.D., Pickel, J.M., Anovitz, L.M., Heller, W.T. and Rondinone, A.J. (2006) Self-assembled colloidal crystals from ZrO₂ nanoparticles. *J. Phys. Chem. B.*, 110, 19456-19460.
- Anovitz, L.M., Riciputi, L.R., Cole, D.R., Elam, J.M., and Gruskiewicz, M.S. (2006) The effect of changes in relative humidity on rates of obsidian hydration. *J. Non-Cryst. Solids* 352, 5652-5662.
- Anovitz, L.M., Elam, J.M., Riciputi, L.R., Cole, D.R. and Fayek, M. (2006) Obsidian hydration: a new paleothermometer, *Geology* 34 (7), 517-520.
- Ziemniak, SE, Palmer, DA, Benezeth, P, and Anovitz, LM (2005) Solubility of litharge (α -PbO) in alkaline media at elevated temperatures. *J. Solution Chemistry*, 34(12), 1407-1428.
- Fayek, M.J., Utsunomiya, S., Pfiffner S.M., White, D.C. Riciputi, L.R., Ewing, R.C., Anovitz, L.M., and Stadermann, F.J. (2005) The application of HRTEM techniques and Nanosims to chemically and isotopically characterize *Geobacter Sulfurreducens* surfaces. *Canadian Mineralogist*, 43, 1631-1641.
- Zhang, Z, Fenter, P., Cheng, L., Sturchio, NC, Bedzyk, MJ, Machesky, ML, Anovitz, LM and Wesolowski, DJ (2005) Zn²⁺ and Sr²⁺ Adsorption at the TiO₂ (110)-Electrolyte Interface: Influence of Ionic Strength, Coverage, and Anions. *J. Colloid Science*, 295(1), 50-64.
- Anovitz, L.M., Elam, J.M. Riciputi, L.R. and Cole, D.R. (2004) Isothermal time-series determination of the rate of H₂O diffusion in Pachuca Obsidian. *Archaeometry* 46(2), 301-326.
- Anovitz, L.M., Labotka, T.C., Blencoe, J.G., and Horita, J. (2004) Experimental determination of the activity-composition relations and phase equilibria of H₂O-CO₂-NaCl fluids at 500°C, 500 bars. *Geochim. Cosmochim. Acta* 68 (17), 3557-3567
- Wesolowski, D.J., Ziemniak, S.E, Anovitz, L.M, Machesky, M.L., Bénézech, P. and Palmer D.A. (2004) Solubility and Surface Adsorption Characteristics of Metal Oxides. In: *Aqueous Systems at Elevated Temperatures and Pressures: Physical Chemistry in Water, Steam and Hydrothermal*. Ed. by D.A. Palmer and R. Fernández-Prini and A.H. Harvey. Ch. 14, 493-595.
- Wesolowski, D.J., Anovitz, L.M., Bénézech, P., Chialvo, A.A., Palmer, D.A., Fenter, P., Cheng, L., Sturchio, N.C., Zhang, Z., Bedzyk, M.J., Kubicki, J.D., Fedkin, M.V., Lvov, S.N., Sykes, D., Cummings, P.T., Ridley, M.K., Machesky, M.L., Predota, M., and Bandura, A.V. (2004) Temperature-Effects and Structure at the Rutile-Water Interface. 2004 Water-Rock Interaction Symposium, Saratoga Springs, NY, USA.
- Zhang, Z., Fenter, P., Cheng, L., Sturchio, N.C., Bedzyk, M.J., Predota, M., Bandura, M.A., Kubicki, J., Lvov, S.N., Cummings, P.T., Chialvo, A.A., Ridley, M.K., Bénézech, P., Anovitz, L.M., Palmer, D.A., Machesky, M. L., Wesolowski, D.J. (2004) Ion Adsorption at the Rutile-Water Interface: Linking Molecular and Macroscopic Properties. *Langmuir* 20, 4954-4969.
- Labotka, T.C., Anovitz, L.M. and Blencoe, J.G. (2002) Pore pressure during metamorphism of carbonate rock: effect of volumetric properties of H₂O-CO₂ mixtures. *Contrib. Mineral Petrol.* 144, 305-313.
- Riciputi, L.R., Elam, J.M., Anovitz, L.M. and Cole, D.R. (2002) Obsidian diffusion dating by secondary ion mass

spectrometry: a test using results from Mound 65, Chalco, Mexico. *J. Arch. Sci.*, 29, 1055-1075.

- Palmer, D.A., Bénézeth, P., Wesolowski, D.J. and Anovitz, L.M. (2002) Impact of Nickel Oxide Solubility on PWR Fuel Deposit Chemistry” EPRI Report 1003155
- Wesolowski, D.J., Machesky, M.L., Palmer, D.A., Ridley, M.K., Bénézeth, P., Anovitz, L.M., Zhang, Z. and Fenter, P. (2002) Ion Adsorption on Metal Oxide Surfaces in Aqueous Solutions to 300°C. Fifth International Conference on Solvothermal Reactions (ICSTR), July 22-26, East Brunswick, New Jersey.
- Blencoe, J.G., Naney, M.T. and Anovitz, L.M. (2001) The CO₂-H₂O system III. A new experimental method for determining liquid-vapor equilibria at high subcritical temperatures. *Amer. Mineral.*, 1100-1111.
- Wesolowski, D.J., Palmer, D.A., Bénézeth, P., Anovitz, L.M., Machesky, M.L., and Ridley, M.K. (2000) Surface Charge and Ion adsorption on metal oxides to 290°C. Proceedings of the World Geothermal Congress 2000, Kyushu-Tohoku, Japan. May 28-June 10, 2000.
- Bénézeth, P. Palmer, D.A., Wesolowski, D.J. and Anovitz, L.M. (2000) Solubility and reaction rates of aluminum solid phases under geothermal conditions. Proceedings of the World Geothermal Congress 2000, Kyushu-Tohoku, Japan, May 28-June 10, 2000, 2533-2537.
- Wesolowski, D.J., Machesky, M.L., Palmer, D.A. and Anovitz, L.M. (2000) Magnetite surface charge studies to 290°C from *in situ* pH titration. *Chemical Geology*, 167, 193-229.
- Anovitz, L.M., Labotka, T.C., Blencoe, J.G., Singh, J. and Horita, J. (2000) Experimental determination of the activity-composition relations and phase equilibria of H₂O-CO₂-NaCl fluids. In: *Steam, Water and Hydrothermal Systems: Physics and Chemistry, Meeting the Needs of Industry. Proceedings of the 13th International Conference on the Properties of Water and Steam*. Eds. P. Tremaine, P.G. Hill, D. Irish and P.V. Balakrishnan. 207-214. NRC Press, Ottawa.
- Wesolowski, D.J., Palmer, D.A., Machesky, M.L., Anovitz, L.M., Hyde, K.E., and Hayashi, K.-I. (2000) Solubility and surface charge characteristics of magnetite in hydrothermal systems. In: *Steam, Water and Hydrothermal Systems: Physics and Chemistry, Meeting the Needs of Industry. Proceedings of the 13th International Conference on the Properties of Water and Steam*. Eds. P. Tremaine, P.G. Hill, D. Irish and P.V. Balakrishnan. 754-763. NRC Press, Ottawa.
- Singh, J., Blencoe, J.G. and Anovitz, L.M. (2000) Volumetric properties and phase relations of binary H₂O-CO₂-CH₄-N₂ mixtures at 300°C and pressures to 1000 bars. In: *Steam, Water and Hydrothermal Systems: Physics and Chemistry, Meeting the Needs of Industry. Proceedings of the 13th International Conference on the Properties of Water and Steam*. Eds. P. Tremaine, P.G. Hill, D. Irish and P.V. Balakrishnan. 134-143. NRC Press, Ottawa.
- Blencoe, J.G., Anovitz, L.M., Singh, J. (2000) A semi-empirical excess pressure equation for CO₂-H₂O fluids at 400°C, 0-400 MPa. In: *Steam, Water and Hydrothermal Systems: Physics and Chemistry, Meeting the Needs of Industry. Proceedings of the 13th International Conference on the Properties of Water and Steam*. Eds. P. Tremaine, P.G. Hill, D. Irish and P.V. Balakrishnan. 126-133. NRC Press, Ottawa.
- Maya, L., Anovitz, L.M. Thundat, T., and Yust, C.S. (1999) Optical and mechanical consequences of microstructural alteration of alpha platinum dioxide films. *Journal of Vacuum Science and Technology*, 17A, 1036-1039.
- Anovitz, L.M., Elam, J.M., Riciputi, L.R. and Cole, D.R. (1999) The failure of obsidian hydration dating: sources, implications and new directions. *Journal of Archaeological Science*, 26, 735-752.
- Blencoe, J.G., Seitz, J.C., and Anovitz, L.M. (1999) The H₂O-CO₂ system. II. Calculated thermodynamic mixing properties for 400°C and 1-4000 bars. *Geochim. Cosmochim. Acta.* 63(16), 2393-2408.
- Anovitz, L.M. and Blencoe, J.G. (1999) The dry melting of high albite. *Amer. Mineral.* 84, 1830-1842.
- Anovitz, L.M., Blencoe, J.G., Joyce, D.B. and Horita, J. (1998) Precise measurement of the activity-composition relations of H₂O-N₂ and H₂O- CO₂ fluids at 500°C, 500 bars. *Geochim. Cosmochim. Acta.*, 62, 815-829.
- Bamberger, C.E., Specht, E.D., and Anovitz, L.M. (1998) Compounds and solid-solutions of cobalt, copper phosphates. *J. Amer. Ceram. Soc.* 81(11), 2799-2804.

- Bamberger, C.E., Specht, E.D. and Anovitz, L.M. (1997) Crystalline copper phosphates; synthesis and thermal stability. *J. Amer. Ceram. Soc.* 80(12), 3133-3138.
- Palmer, D.A., Bénézeth, P., Wesolowski, D.J., Anovitz, L.M., Machesky, M.L., Hayashi, K.-I., and Hyde, K.E. (1997) Solubility of, and hydrogen ion adsorption on, some metal oxides in aqueous solutions to high temperatures. Proceedings of the Fifth International Conference on Cycle Chemistry in Fossil Plants, EPRI. Charlotte, North Carolina. B. Dooley and J Mathews, Eds. Electric Power Research Institute Technical Report TR-108459.
- Hemingway, B.S., Evans, H.T. Jr. Mazdab, F.K. and Anovitz, L.M. (1996) Thermal expansion of some borate and borosilicate minerals (fluorborite, danburite, sinhalite, datolite, elbaite, dravite, kornerupine, dumortierite, ferroaxinite and manganaxinite) between 25 and about 1200°C. *U.S. Geological Survey Open - File Report*. 96 - 100. 15 pp.
- Anovitz, L.M. and Hemingway, B.S. (1996) Thermodynamics of boron minerals: a summary of structural, volumetric and thermochemical data. In: Boron: Mineralogy, Petrology and Geochemistry, E. Grew and L.M. Anovitz eds. *Mineralogical Society of America Reviews in Mineralogy*, V33, Ch. 5, 181-262.
- McGee, J. and Anovitz, L.M. (1996) Microprobe analysis of boron in geologic samples. In: Boron: Mineralogy, Petrology and Geochemistry, E. Grew and L.M. Anovitz eds. *Mineralogical Society of America Reviews in Mineralogy*, V33, Ch. 15, 771-788.
- Anovitz, L.M. and Grew, E.S. (1996) The mineralogy, petrology and geochemistry of boron: an introduction. In: Boron: Mineralogy, Petrology and Geochemistry, E. Grew and L.M. Anovitz eds. *Mineralogical Society of America Reviews in Mineralogy*, V33, Ch. 1, 1-40.
- Hemingway, B.S., Mazdab, F.K. and Anovitz, L.M. (1996) Heat capacity and thermodynamic properties for two samples of prismaticine. *U.S. Geological Survey Open - File Report*. 96 - 508, 9 pp.
- Shoup, S.S., Bamberger, C.E., Tyree, J.L. and Anovitz, L.M. (1996) Lanthanide-containing zircono-titanate solid-solutions. *J. Solid State Chemistry*, 127, 231-239.
- Komada, N.L., Westrum, E.F., Jr., Hemingway, B.S., Zolotov, M. Yu., Semenov, Y.V. Khodakovskiy, I.L. and Anovitz, L.M. (1995) Thermodynamic properties of sodalite at temperatures from 15 K to 1000 K. *J. Chem. Therm.*, 27, 1119 - 1132.
- Komada, N., Westrum, E.F., Jr., Hemingway, B.S., and Anovitz, L.M. (1995) Thermodynamic properties of two iron silicates. Heat capacities of deerite from the temperature 10 K to 700 K and grunerite from 10 to 1000 K. *J. Chem. Therm.*, 27, 1097 - 1118.
- Essene, E.J., Anovitz, L.M. and Perkins, D. (1994) Mineral metastability in the system $\text{Al}_2\text{O}_3 - \text{SiO}_2 - \text{H}_2\text{O}$: A reply. *Clays and Clay Minerals*. 42, 98 - 105.
- Anovitz, L.M., Essene, E.J., Metz, G.W., Bohlen, S.R., Westrum, E.F., Jr., and Hemingway, B.S. (1993) Heat capacity and phase equilibria of almandine, $\text{Fe}_2\text{Al}_2\text{Si}_3\text{O}_{12}$. *Geochim. Cosmochim. Acta.*, 57, 4191-4204.
- Anovitz, L.M., Perkins, D., III, and Essene, E.J. (1991) Metastability in near-surface rocks of minerals in the system $\text{Al}_2\text{O}_3\text{-SiO}_2\text{-H}_2\text{O}$. *Clays and Clay Minerals*, 225 - 233.
- Anovitz, L.M. (1991) Al - zoning in pyroxene and plagioclase: window on late prograde/early retrograde P-T paths in granulite terranes. *Amer. Mineral.*, 91, 1328 - 1343.
- McClelland, W.C., Anovitz, L.M. and Gehrels, G.E. (1991) Thermobarometric constraints on the structural evolution of the Coast Mountains batholith, central southeastern Alaska. *Can. J. Earth Sci.*, 28, 912 - 928.
- Mottana, A., Paris, E., Davoli, I., and Anovitz, L.M. (1991) Determining Fe-Mg intersite distribution in natural and heated orthopyroxenes by synchrotron X-ray absorption spectroscopy. *Rend. Fis. Acc. Lincei*, 9, 379 - 387.
- Anovitz, L.M., and Essene, E.J. (1990). Thermobarometry and pressure-temperature paths in the Grenville Province of Ontario. *J. Petrology* 31, 197-241.
- Anovitz, L.M., and Chase, C.G. (1990). P/T paths in Grenville granulites: Implications of extension, flexural isostasy and underplating. *Geology* 18, 466-469.
- Anovitz, L.M., Hemingway, B.S., Robie, R.A., and McGee, J.J. (1990) The thermodynamic properties of dumortierite

(Si₃B(Al_{6.75}[]_{0.25})O_{17.25}(OH)_{0.75}). *Amer. Mineral.*, 75, 1370 - 1375.

Anovitz, L.M., Essene, E.J., and Dunham, W.R. (1988). Order/disorder experiments on orthopyroxenes: Implications for the orthopyroxene geospeedometer. *Am. Mineral.* 73, 1060-1074.

Moecher, D.P., Anovitz, L.M., and Essene, E.J. (1988). Two new garnet geobarometers in the system CaO-MgO-FeO-Al₂O₃-SiO₂. *Contrib. Mineral. Petrol.* 100, 92-106.

Anovitz, L.M., and Essene, E.J. (1987). Phase equilibria in the system CaCO₃-MgCO₃-FeCO₃. *J. Petrol.* 28, 389-414.

Anovitz, L.M., Hemingway, B.S., Westrum, E.F., Jr., Metz, G.W., and Essene, E.J. (1987). The heat capacity of cryolite: Phase relations in the system Na-Fe-Al-Si-O-F. *Geochim. Cosmochim. Acta* 51, 3087-3104.

Anovitz, L.M., and Essene, E.J. (1987). Intercomparison of garnet barometers in the system CaO-FeO-Al₂O₃-SiO₂-TiO₂ (CFAST): Implications for garnet mixing models. *J. Geology* 45, 633-645.

Sharp, Z.D., Essene, E.J., Anovitz, L.M., Metz, G.W., Westrum, E.F., Jr., Hemingway, B.S., and Valley, J.W. (1986). The heat-capacity of a natural monticellite and phase equilibria in the system CaO-MgO-SiO₂-CO₂. *Geochim. Cosmochim. Acta* 50, 1475-1484.

Anovitz, L.M., Treiman, A.H., Hemingway, B.S., Essene, E.J., Westrum, E.F., Jr., Wall, V.J., Burriel, R., and Bohlen, S.R. (1985). The heat-capacity of ilmenite and phase equilibria in the system Fe-Ti-O. *Geochim. Cosmochim. Acta* 49, 2027-2040.

Peterson, E.U., Anovitz, L.M., and Essene, E.J. (1984). Donpeacorite (Mn,Mg)MgSi₂O₆, a new orthopyroxene in the system MnSiO₃-MgSiO₃. *Amer. Mineral.* 69, 472-480.

Yau, Y-C., Anovitz, L.M., Essene, E.J., and Peacor, D.R. (1984). Phlogopite-chlorite reaction mechanisms and physical conditions during retrograde reactions in the Marble Formation, Franklin, New Jersey. *Contrib. Mineral. Petrol.* 88, 299-306.

Edited Volumes

Steeffel, C.I., Emmanuel, S., and Anovitz, L.M. (2015) Pore-Scale Geochemical Processes. Reviews in Mineralogy and Geochemistry, Vol. 80, 482p.

Grew, E. S. and Anovitz, L.M. (2002) Boron: Mineralogy, Petrology and Geochemistry. *Mineralogical Society of America Reviews in Mineralogy*, V33, second printing, with corrections and additions. 864p.

Grew, E. S. and Anovitz, L.M. (1996) Boron: Mineralogy, Petrology and Geochemistry. *Mineralogical Society of America Reviews in Mineralogy*, V33. 862p.

Book Reviews

Anovitz, L.M. Review of: Principles of Mineralogy. By W.H. Blackburn and W.H. Dennen, Wm. C. Brown, Dubuque, Iowa, 1988. xvi + 413 pages. *Amer. Mineral.*, (accepted, never published).

Patents

Blencoe, J.G., Anovitz, L.M., Palmer, D.A., and Beard, J.S. (2003) Carbonation of metal silicates for long-term CO₂ sequestration (ORNL 1217). Patent Pending.

Blencoe, J.G., Anovitz, L.M., Palmer, D.A., and Beard, J.S. (2005) Production of magnesium metal (ORNL 1405). Patent Pending.

Blencoe, J.G., Anovitz, L.M., Palmer, D.A., and Beard, J.S. (2005) Production of magnesium metal, continuation in part (ORNL 1405-2). Patent Pending.

Blencoe, J.G., Anovitz, L.M., Palmer, D.A., and Beard, J.S. (2006) Method of extracting lithium (ORNL 1456). Patent Pending.

Videos

Anovitz, L.M., Elam, J.M., Riciputi, L.R. and Cole, D.R. (1998) Optical phenomena associated with hydrated obsidian. First presented at the 1998 Society for American Archaeology meeting, Seattle, WA March 26, 1998.

Anovitz, L.M. (2003) Diamond Anvil Cell Training, 2002.

Submitted

Rondinone, AJ, Anovitz, LM, and Wesolowski, DJ (in sub.) Solvothermal Synthesis of Single-Crystal, Hexagonally Faceted Quartz Nanorods. Particle and Particle Systems Characterization.

Rother, G, Anovitz, LM, Wang, X, Dai, S, Hjelm, RP, Hartl, M, Littrell, KC, Debeer-Schmitt, LM, Cole, DR, and Wesolowski, DJ (2011) Density of room-temperature ionic liquids confined in disordered mesoporous carbon. Phys. Chem. Chem Phys., submitted

Deangelis, MT, Labotka, TC, Fayek, M, Cole, DR, and Anovitz, LM (2011) Oxygen transport and exchange in dolomite rock at 700°C, 100 MPa. American Mineralogist, submitted.

Brady, MP, Fayek, M, Elsentriecy, HH, Unocic, KA, Anovitz, LA, Keiser, JR, Song, G-L, and Davis, B (in sub.) Tracer film growth study of hydrogen and oxygen uptake from the corrosion reaction of magnesium in water. Journal of the Electrochemical Society.

Reports

Anovitz, LM and Smith, B (2014) Lifecycle Verification of Tank Polymer Liners. ORNL Report. ORNL/TM-2014/48.

Palmer, D.A., Anovitz, L.M., and Wilson, L.L. (2007) Solubility of zinc silicate and zinc ferrite in aqueous solution at light water reactor temperatures, Final Report, November, 2007. To: Electric Power Research Institute (EPRI), Bo Cheng, Program Manager, EPRI, Palo Alta, California, 1015035.

Palmer, D.A., Anovitz, L.M., and Wilson, L.L. (2007) Solubility of zinc silicate and zinc ferrite in aqueous solution to high temperatures, Final Report, March, 2007. To: Electric Power Research Institute (EPRI), Bo Cheng, Program Manager.

Palmer, D.A., Wilson, L.L., Anovitz, L.M., and Gruskiewicz, M.S. (2006) Solubility of zinc silicate and zinc ferrite in aqueous solution to high temperatures, Interim Report, February 17, 2006. To: Electric Power Research Institute (EPRI), Bo Cheng, Program Manager.

Palmer, D.A., Gruskiewicz, M.S., Wilson, L.L. and Anovitz, L.M. (2005) Solubility Behavior of Non-stoichiometric Zinc Ferrite in Hydrogenated Solutions, Interim Report. December 31, 2005. To: Knolls Atomic Power Laboratory S.E. Ziemniak, Program Manager

Palmer, D.A., Bénézeth, P., Wesolowski, D.J. and Anovitz, L.M. (2004) Final report on the project: Measure/Report on the solubility of lead oxide, Project No. WF066401, May 10, 2004. To: Knolls Atomic Power Laboratory S.E. Ziemniak, Program Manager

Palmer, D.A., Bénézeth, P., Wesolowski, D.J. and Anovitz, L.M. (2003) Interim report on the project: Measure/Report on the solubility of lead oxide, Project No. WF066401, December 2, 2003. To: Knolls Atomic Power Laboratory S.E. Ziemniak, Program Manager

Wesolowski, D.J., Bénézeth, P., Palmer, D.A., and Anovitz, L.M. (2002) Protonation constants of morpholine, dimethylamine and ethanolamine to 290C and the effect of morpholine and dimethylamine on the surface charge of magnetite at 150-250C. EPRI Technical Report 1003179.

Anovitz, L.M., Wesolowski, D.J. and Simonson, J.M. (2002) Thermodynamics of Cr₂O₃, FeCr₂O₄, ZnCr₂O₄ and CoCr₂O₄: Final report. April 19, 2001. To: Knolls Atomic Power Laboratory, S.E. Ziemniak, Program Manager.

Palmer, D.A., Wesolowski, D.J. Anovitz, L.M. and Machesky, M.L. (2001) Adsorption of Ions on zirconium oxide

- surfaces from aqueous solutions at high temperatures. Final report, December, 2001. To: Electric Power Research Institute (EPRI), P. Frattini, Program Manager.
- Anovitz, L.M., Wesolowski, D.J. and Simonson, J.M. (2001) Thermodynamics of Cr_2O_3 , FeCr_2O_4 , ZnCr_2O_4 and CoCr_2O_4 : Interim report of progress. September 30, 2001. To: Knolls Atomic Power Laboratory, S.E. Ziemniak, Program Manager.
- Wesolowski, D.J., Palmer, D.A., Anovitz, L.M. and Machesky, M.L. (2000) Adsorption of ions on metal oxide surfaces from aqueous solutions at high temperature. Final report on Zinc and Nickel Ferrite surface charge studies, December 31, 2000. To: Knolls Atomic Power Laboratory, S.E. Ziemniak, Program Manager.
- Palmer, D.A., Bénézeth, P., Petrov, Y.A., Anovitz, L.M., and Simonson, J.M. (2000) Behavior of Aqueous Electrolytes in Steam Cycles: The Solubility and Volatility of Cupric Oxide. Electric Power Research Institute (EPRI) Technical Report 1000455. Final Report, November, 2000. R.B. Dooley, EPRI Project Manager.
- Xiao, C., Wesolowski, D.J., Palmer, D.A., Anovitz, L.M., and Bénézeth, P., (2000) Solubility of chromium spinels at elevated temperatures. Final report on solubility studies of CoCr_2O_4 , October 15, 2000. To: Knolls Atomic Power Laboratory, S.E. Ziemniak, Program Manager.
- Xiao, C., Wesolowski, D.J., Palmer, D.A., Anovitz, L.M., and Bénézeth, P., (2000) Solubility of chromium spinels at elevated temperatures. Interim progress report on the solubility of cobalt chromite, CoCr_2O_4 , May 31, 2000. To: Knolls Atomic Power Laboratory, S.E. Ziemniak, Program Manager.
- Xiao, C., Wesolowski, D.J., Palmer, D.A., Anovitz, L.M., and Bénézeth, P., (2000) Solubility of chromium spinels at elevated temperatures. Interim progress report on the solubility of cobalt chromite, CoCr_2O_4 , January 31, 2000. To: Knolls Atomic Power Laboratory, S.E. Ziemniak, Program Manager.
- Xiao, C., Wesolowski, D.J., Palmer, D.A., Anovitz, L.M., and Bénézeth, P., (1999) Solubility of chromium spinels at elevated temperatures. Final report on solubility studies of ZnCr_2O_4 , December 3, 1999. To: Knolls Atomic Power Laboratory, S.E. Ziemniak, Program Manager.
- Wesolowski, D.J., Palmer, D.A., Anovitz, L.M. and Machesky, M.L. (1999) Adsorption of ions on metal oxide surfaces from aqueous solutions at high temperature. Progress report on Zinc and Nickel Ferrite surface charge studies, November 30, 1999. To: Knolls Atomic Power Laboratory, S.E. Ziemniak, Program Manager.
- Xiao, C., Wesolowski, D.J., Palmer, D.A., Bénézeth, P., and Anovitz, L.M. (1999) Solubility of chromium spinels at elevated temperatures. Interim report of progress, March 30, 1999. To: Knolls Atomic Power Laboratory, S.E. Ziemniak, Program Manager.
- Wesolowski, D.J., Palmer, D.A., Anovitz, L.M. and Machesky, M.L. (1999) Adsorption of ions on metal oxide surfaces from aqueous solutions at high temperature. Progress report on Zinc and Nickel Ferrite surface charge studies, June 30, 1999. To: Knolls Atomic Power Laboratory, S.E. Ziemniak, Program Manager.
- Wesolowski, D.J., Palmer, D.A., Anovitz, L.M. and Mesmer, R.E. (1998) Adsorption of ions on metal oxide surfaces from aqueous solutions at high temperature. Interim report of activities, March 31, 1998. To: Knolls Atomic Power Laboratory, S.E. Ziemniak, Program Manager.
- Wesolowski, D.J., Palmer, D.A., Xiao, C., Bénézeth, P., Anovitz, L.M. and Mesmer, R.E. (1998) Solubility of chromium spinels at elevated temperatures. Interim report of progress, September 30, 1998. To: Knolls Atomic Power Laboratory, S.E. Ziemniak, Program Manager.
- Palmer, D.A., Wesolowski, D.J., Bénézeth, P., Anovitz, L.M., Mesmer, R.E., and Machesky, M.L. (1997) Adsorption of ions on metal oxide surfaces from aqueous solutions at high temperature: final report on zinc oxide surface adsorption and solubility studies. August 31, 1997. To: Knolls Atomic Power Laboratory, S.E. Ziemniak, Program Manager.
- Palmer, D.A., Bénézeth, P., Wesolowski, D.J., Anovitz, L.M., Machesky, M.L., Hayashi, K.-I., and Hyde, K.E. (1997) Solubility of, and hydrogen ion adsorption on, some metal oxides in aqueous solutions to high temperatures. DOE Report DE97008238, CONF-970623--1 12/31/97.
- Wesolowski, D.J., Palmer, D.A., Anovitz, L.M., and Mesmer, R.E. (1997) Solubility of Chromium Spinels at Elevated Temperatures: Interim report of progress, May 15, 1997. To: Knolls Atomic Power Laboratory, S.E. Ziemniak, Program Manager.

Wesolowski, D.J., Palmer, D.A., Anovitz, L.M. and Mesmer, R.E. (1997) Solubility of chromium spinels at elevated temperatures. Interim report of progress, December 31, 1997. To: Knolls Atomic Power Laboratory, S.E. Ziemniak, Program Manager.

Palmer, D.A., Wesolowski, D.J., Bénézeth, P., Anovitz, L.M., Mesmer, R.E., and Machesky, M.L. (1996) Adsorption of ions on metal oxide surfaces from aqueous solutions at high temperature. To: Knolls Atomic Power Laboratory, S.E. Ziemniak, Program Manager.

Invited Talks

Anovitz, LM (2011) Structure and dynamics of fluid transport in geologic systems: porosity and bulk diffusion. 2011 LANSCE neutron Scattering School, LANL, Los Alamos, New Mexico, July 19th, 2011.

Anovitz, L.M. (2009) Obsidian Hydration: Mechanisms and Dating Archaeological Artifacts. ASM (American Society of Materials), Knoxville, Tennessee, January 15, 2009.

Feng, Z., and Anovitz, L.M. (2008) hydrogen diffusion in steels. NIST Diffusion Workshop, May 12, 13, 2008, Gaithersburg, Md.

Anovitz, L.M. (2005) Obsidian Hydration Dating: Old Problems and New Approaches to Glass Corrosion. Archaeology Field School, Tremont Institute. June 17, 2005.

Babu, S. S., Feng, Z., Santella, M.L., David, S.A., Blencoe, J.G., Anovitz, L.M. and Korinka, P.S. (2005) Hydrogen permeability and integrity of hydrogen transfer pipelines, DOE Hydrogen Pipeline R & D Project Review meeting. January 5, 2005.

Anovitz, L.M. (2004) Obsidian Hydration Dating: Old Problems and New Approaches to Glass Corrosion. Department of Earth and Planetary Sciences, University of Tennessee. September 9, 2004.

Anovitz, L.M. (2004) Obsidian Hydration Dating: Old Problems and New Approaches to Glass Corrosion. University of Arizona, IGERT Lecture. February 6, 2004.

Anovitz, L.M. (2003) Experimental and Model Approaches to Understanding "Water" Diffusion in Glass. University of North Dakota. November 7, 2003

Anovitz, L.M. (2003) Obsidian Hydration Dating: Old Problems and New Approaches to Glass Corrosion. University of North Dakota, LEEPS Lecture. November 7, 2003.

Anovitz, L.M. (2003) Obsidian Hydration Dating: Old Problems and New Approaches to Glass Corrosion. University of Tennessee. February 20, 2003.

Anovitz, L.M. (2003) Obsidian Hydration Dating: Old Problems and New Approaches to Glass Corrosion. University of Georgia, Athens. February 6, 2003.

Anovitz, L.M. (1999) The failure of obsidian hydration dating: sources, implications and new directions. Department of Anthropology, University of Tennessee. October 7, 1999.

Anovitz, L.M. (1993) Electrochemistry of rock-forming minerals. Department of Energy, Office of Basic Energy Sciences, OPA review, July 14, 1993.

Anovitz, L.M. (1993) Electrochemistry of rock-forming minerals. Department of Energy, Office of Basic Energy Sciences workshop, July 15, 1993.

Anovitz, L.M. (1993) Electrochemistry and Thermochemistry of Rock-Forming Minerals: Oxides and Pyroxenes. Sandia National Laboratories, August 30, 1993.

Anovitz, L.M. (1993) Electrochemistry and Thermochemistry of Rock-Forming Minerals: Oxides and Pyroxenes. Oak Ridge National Laboratories, October 6, 1993.

Anovitz, L.M. High-temperature metamorphism around the Marble Canyon Intrusion, West Texas, University of Tennessee, October 7, 1993.

Anovitz, L.M. (1993) Electrochemistry and Thermochemistry of Rock-Forming Minerals: Oxides and Pyroxenes. Oak

Ridge National Laboratories, October 8, 1993.

Anovitz, L.M. High-temperature metamorphism around the Marble Canyon Intrusion, West Texas, Oak Ridge National Laboratories, June 22, 1993.

Anovitz, L.M. Minerals in thin section, Tucson Gem and Mineral Society, November 4, 1991.

Anovitz, L.M., Kalin, R.M. and Ruiz, J. (1991) High-temperature contact metamorphism: Marble Canyon west Texas. *GSA Abst. w. Prog., Mineralogical Society of America Symposium. Contact Metamorphism*, 22, A50.

Anovitz, L.M. A re-evaluation of activity/composition relations on the join diopside - enstatite. *GSA meeting, 1990, Mineralogical Society of America Symposium. Mineral Solid Solutions: Thermodynamics and Petrological Applications*.

Anovitz, L.M. Pressures, temperatures, and P-T-t paths in granulites: a Grenville example. Arizona State University, November 28, 1990.

Anovitz, L.M. Pressures, temperatures, and P-T-t paths in granulites: a Grenville example. University of Texas, El Paso, January 29, 1990.

Anovitz, L.M. High-temperature metamorphism around the Marble Canyon Intrusion, West Texas, University of Texas, El Paso, January 29, 1990.

Anovitz, L.M., and Essene, E.J. (1990). Constraints on the pressure-temperature-time history of the Grenville Province, Ontario. *GSA Northeastern Section Abst. w. Prog. 22(2)*, 3.

Anovitz, L.M. (1986) Metamorphic thermobarometry in the Grenville Province, Ontario. *GAC/MAC 1986 Field Trip 6*.

Abstracts and Presentations

Anovitz, L.M., and Cole, D.R. (2015) Characterization and analysis of porosity and pore structures. Short course on Pore-Scale Geochemical Processes, Prague, Aug, 2015, invited.

Anovitz, LM, Cole, Dr, Rother, G, Stack, AG, Novack, C, Kolbus, L, DiStefano, V, and Ajo-Franklin, J (2014) Reaction and flow in shale fractures. NCGC all hands meeting.

Anovitz, LM, Novack, C, Prisk, T, Ilavsky, J, Hammons, J, Mildner, D, Wasbrough, M, Jacobson, D, and Hussey, D (2015) Multiscale effects of reactivity and flow rate on porosity during dissolution of carbonates. Goldschmidt Meeting, Prague.

Anovitz, LM, Novack, C, Prisk, T, Ilavsky, J, Hammons, J, Mildner, D, Wasbrough, M, Jacobson, D, and Hussey, D (2015) Multiscale effects of reactivity and flow rate on porosity during dissolution of carbonates. American Chemical Society, invited.

Anovitz, LM, Bilheux, HZ, Bingham, P, Cheshire, M, Distafano, V, Hale, R, Kolbus, L, McFarlane, J, and Perfect, E (2015) Visualizing hydraulic fracturing processes and assessing effective fracking fluids using neutron imaging. SNS User group meeting.

Kolesnikov, AI, Anovitz, LM, Ehlers, G, Mamontov, E, Podlesnkak, AA, Prisk, TR, Seel, A, and Reiter, G (2015) Quantum tunneling of ultra-confined water. XVIIth International Workshop on Quantum Atomic and Molecular Tunneling in Solids and other Phases.

Prisk, TR, Kolesnikov, AI, Mamontov, E, and Anovitz, LM (2015) Ice-like Behavior of Ultra-Confined Water. Am Phys. Soc. Meeting.

Rother, G, Stack, AG, Cheshire, MC, Anovitz, LM, Swift, A, Cole, DR, and Bourg, I (2015) Nanoscale Properties of CO₂-Water Mixtures Confined in Rock Pores. NCGC all hands meeting.

- Rother, G, Vlcek, L, Swift, A, Anovitz, LM, Stack, AG, Sheets, J, and Cole, DR (2015) Nanoscale Aspects of CO₂ Storage in Geologic Formations. Carbon Storage R&D Project Review Meeting, Aug. 19, 2015.
- Swift, A, Sheets, J, Cole, CR, Anovitz, LM and Rother, G (2015) From the Nano- to the Formation Scale: Accessible Reactive Surface Area in a CO₂ Saline Reservoir, Fall AGU.
- DiStefano, VH, McFarlane, J, Anovitz, LM, Gordon, AD, Hale, RE, Hunt, RD, Lewis, S, Littrell, K, Stack, AG, Chipera, S, Perfect, E, Bilheux, HZ, and Kolbus, LM (2015) Using Neutrons to Study Fluid-Rock Interactions. 2015 SERMACS – SWRM meeting.
- DiStefano, VH, McFarlane, J, Anovitz, LM, Gordon, AD, Hale, RE, Hunt, RD, Lewis, S, Littrell, K, Stack, AG, Chipera, S, Perfect, E, Bilheux, HZ, and Kolbus, LM (2015) Using Neutrons to Study Fluid-Rock Interactions. 2015 SNS User group meeting.
- DiStefano, VH, McFarlane, J, Anovitz, LM, Gordon, AD, Hale, RE, Hunt, RD, Littrell, K, Lewis, S, Stack, AG, Chipera, S, Perfect, (in subm.) Extraction of Organic Compounds from Representative Shales and the Effect on Porosity. Fall AGU meeting.
- Emmanuel, S.; Anovitz, L. M.; Day-Stirrat, R. J. (2015) Effects of Coupled Chemo-Mechanical Processes on the Evolution of Pore-Size Distributions in Geological Media. Short course on Pore-Scale Geochemical Processes, Prague, Aug, 2015, invited.
- Kolbus, LM, Anovitz, LM, Chakoumakos, BC, Wesolowski, DJ (2014) Fracture Toughness and Fatigue Properties of Pipeline Base Steels and Welds in High-Pressure Hydrogen and Technologies for Improving Weld HE and IGSCC Resistance for Alternative Fuel Pipelines. American Geophysical Union.
- Anovitz, LM, Cole, DR, Swift, A, Sheets, J, Elston, H, Welch, S, Chipera, SJ, Littrell, KC, Mildner, DFR, and Wasbrough, MJ (2014) Variations in multi-scale (nano to mm) porosity in the Eagle Ford shale as a function of porosity. USANS Workshop, Oak Ridge, Tennessee, June, 2014.
- Anovitz, LM, Rother, G, Gruskiewicz, M, Brantley, SL, Cole, DR, Cummings, PT, McCabe, C, Vlcek, L, Mamontov, E, Kolesnikov, AI and Choudhury, N (2013) Porosity/permeability evolution and pore-confined fluid properties in natural and synthetic geologic media. DOE Geoscience Workshop, May, 2014.
- Kolesnikov, AI, Anovitz, LM, Mamontov, E, Podlesnyak, AA and Ehlers, G. (2014) Vibrational dynamics and tunneling of water in beryl. Goldschmidt Conference, Sacramento, CA.
- Kolesnikov, AI, Anovitz, LM, Mamontov, E, Podlesnyak, AA and Ehlers, G. (2014) Tunneling and vibrational dynamics of ultra-confined water. ACNS-2014. Knoxville, TN. June.
- Anovitz, LM, Cole, DR, Jackson, AJ, Rother, G, Littrell, KC, Allard, LF, Pollington, AD and Wesolowski, DJ (in sub.) Effect of quartz overgrowth precipitation of the multiscale porosity of sandstone: a (U)SANS and imaging analysis. *Geochimica et Cosmochimica Acta*.
- Anovitz, LM, Cole, DR, Swift, A, Sheets, J, Elston, H, Welch, S, Chipera, SJ, Littrell, KC, Mildner, DFR, and Wasbrough, MJ (2014) Variations in multi-scale (nano to mm) porosity in the Eagle Ford shale as a function of porosity. 247th Amer. Chem Soc. Meeting, Dallas, March.
- Wang, HW, Vlcek, L, DelloSritto, MJ, Kumar, N, Wesolowski, DJ, Sofo, JO, Kolesnikov, AI, Kent, PR, Kubicki, JD and Anovitz, LM (2014) Structure and dynamics of the surface-water on SnO₂ nanocrystals. 247th Amer. Chem Soc. Meeting, Dallas, March
- Anovitz, LM, Cole, DR, Rother, G, Littrell, KC, Wasborough, M, Pipich, V, Fu, Z, and Freiburg, JT (2014) **Invited:** (U)SANS and imaging analysis of changes in multiscale porosity in the St. Peter sandstone with burial diagenesis. 248th Amer. Chem. Soc. Meeting, San Francisco, August.

- Vlcek, L, Chialvo, AA, Rother, G, Gruszkiewicz, M, and Anovitz, LM (2014) Development of realistic molecular and mesoscale models of fluids. Dept. of Appl. Mathematics, UTK, Knoxville. Oct, 2013.
- Anovitz, LM, Cole, DR, Swift, A, Sheets, J, Elston, H, Welch, S, Chipera, SJ, Littrell, KC, Mildner, DFR, and Wasbrough, MJ (2014) Multiscale (nano to mm) porosity in the Eagle Ford Shale: Changes as a function of maturity. Unconventional Resources Technology Conference (URTeC Abstract), Denver, August, 2014.
- Stack, Andrew G.; Bracco, Jacquelyn N.; Waychunas, Glenn A, Fernandez-Martinez, A, Rother, G, Anovitz, LM, and Steefel, CI (2013) Calcium carbonate growth rates from the atomic- to pore-scales. 246th National Meeting of the American-Chemical-Society (ACS) Indianapolis, IN, Abstracts Of Papers Of The American Chemical Society, 246, 27-GEOC.
- Cole, DR.; Swift, AM.; Sheets, JM, Welch, SA, Anovitz, LM, Rother, G, and Murphy, MV (2013) Reactive surface area as a function of pore connectivity, geometry, and size distribution in geologic CO₂ storage reservoir formations. 246th National Meeting of the American-Chemical-Society (ACS) Indianapolis, Abstracts Of Papers Of The American Chemical Society, 246, 26-GEOC,
- Bingham, P; Polsky, Y; Anovitz, LM (2013) Neutron imaging for geothermal energy systems. Conference on Image Processing - Machine Vision Applications VI Location: Burlingame, CA, Image Processing: Machine Vision Applications VI Book Series: Proceedings of SPIE, 8661, 86610K.
- Anovitz, LM (2013) Nanometer to centimeter-scale analysis of the effects of geochemical processes on rock porosity: neutron scattering and imaging. BES Geoscience Workshop.
- Anovitz, LM, Cole, DR, R.P. Hjelm, RP, Hartl, M (2013) Multiscale Porosity in Geomaterials: Combined (U)SANS and Imaging Studies. LANSCE/LUJAN/LANL BES Review
- Anovitz, LM, Cole, DR, Swift, A, Sheets, J, Elston, H, Gutierrez, M, Cook, A, Chipera, SJ, Littrell, K, Mildner, DFR, and Wasbrough, M (2013) Variations in Multiscale (nano to mm) Porosity in the Eagle Ford Shale as a Function of Maturity through the Oil Window. American Geophysical Union Fall Meeting, San Francisco.
- Cole, DR, Swift, A, Sheets, J, Welch, S, Anovitz, LM, Rother, G, Vlcek, L (2013) Relationship between Mineralogy and Porosity in Subsurface Formations Relevant to Geologic CO₂ Sequestration. American Geophysical Union Fall Meeting, San Francisco.
- Stack, AG, Steefel, CI, Waychunas, G, Fernandez-Martinez, A, Rother, G, Anovitz, LM, Rothman, DH, and Bracco, JN (2013) Upscaling Carbonate Mineral Growth rates from the Atomic- to Pore-Scales and Beyond: Current Progress and Questions. Twelfth Annual Conference on Carbon Capture, Utilization & Sequestration, Pittsburg, Pennsylvania, May 16, 2013.
- Beckingham, LE, Yang, L, Ajo-Franklin, J, Voltolini, M, Banuelos, JL, Anovitz, LM, Bourg, IC, and Steefel, CI (2013) Chlorite reactivity and contribution to flow path modifications under conditions relevant for CO₂ sequestration. American Geophysical Union Fall Meeting, San Francisco.
- Banuelos, JL, Feng, G, Fulvio, PF, Volker, P, Song, L, Arend, N, Rother, G, Faraone, A, Browning, J, Chathoth, S, Anovitz, LM, Hillesheim, PC, Dai, S, Gogotski, YG, Cummings, PT and Wesolowski, DJ (2013) Ionic liquids and electrolyte solutions at carbon interfaces: Structure and dynamics via SAXS, SANS, NR, NSE, and CMD. 2012 FIRST All-hands Meeting, Seot, 29, 2012.
- Banuelos, JL, Song, L, Feng, G, Fulvio, PF, Arend, N, Rother, G, Faraone, A, Anovitz, LM, Hillesheim, PC, Guo, J, Shaw, RW, Dai, S, Cummings, PT and Wesolowski, DJ (2013) SAXS studies of alkyl chain, temperature, and confinement effects on the structure of room temperature ionic liquids. Center for Nanophase Materials Sciences, Sept 13, 2012.

- Cole, DR, Swift, AM, Sheets, JM, Welch, SA, Anovitz, LM, Rother, G, and Murphy, MV (2013) Reactive surface area as a function of pore connectivity, geometry, and size distribution in geologic CO₂ storage reservoir formations, American Chemical Society, Fall Meeting, Indianapolis, IN
- Cole, DR, Swift, A, Sheets, J, Murphy, M, Welch, S, Anovitz, LM, Rother, G, Vlcek, L (2013) Anatomy of Pore Networks in Caprock Relevant to Geologic CO₂ Sequestration. EFRC PI Meeting, July 18, 19, 2013.
- Rother, G, Anovitz, LM, and Cole, D (2013) Nano to micron scale structure of cap- and reservoir rocks in CO₂ storage sites and CO₂ charged aquifers. Green River Project Meeting, British Geological survey, Keyworth, Nottingham, UK Feb. 26, 2013.
- Wang, H-W, Wesolowski, DJ, Proffen, TE, Vlcek, L, Kolesnikov, AI, Wang, W, Sofo, JO, Kubicki, JD, Kent, PR and Anovitz, LM (2013) Structure and Dynamics of the Surface Water on SnO₂ Nanocrystals. Amer. Cryst. Assoc.
- Wang, H-W, Wesolowski, DJ, Proffen, TE, Vlcek, L, Wang, W, Allard, LF, Kolesnikov, AI, Feygenson, M, Kent, PRC, Anovitz, LM, Sofo, JO, and Paul, RL (2013) Structure and dynamics of the surface water on SnO₂ nanocrystals. SNS/CNMS Seminar, April, 2013.
- Anovitz, LM, Cole, DR, Rother, G, Littrell, KC and Allard, L.F. (2013) Small Angle Neutron Scattering and Imaging Analysis of Multiscale Porosity in the St. Peter Sandstone: Analytical and Experimental Results. American Crystallographic Association, July, 2013.
- Fayek, M, Anovitz, LM, Hawthorne, FC (2013) Provenance studies of Cu-bearing feldspar using Cu isotopes analysis by SIMS. Geological Society of America Fall Meeting.
- Smith, B., and Anovitz, LM (2013) Lifecycle verification of polymer liners in storage tanks. 2013 Hydrogen and Fuel Cell Technology Annual Merit Review
- Anovitz, LM, Wang, H-W, Cole, DR, Sheets, J, Rother, G, Faulder, DD, and Walters, M (2013) Analysis of Multiscale Porosity at the Coso Geothermal Field. Stanford Geothermal Workshop, Stanford, CA.
- Polsky, Y, Anovitz, LM, Bilheux, HZ, Bingham, PR, and Carmichael, JR (2013) Application of Neutron Imaging to Investigate Flow Through Fractures for EG. Stanford Geothermal Workshop, Stanford, CA.
- Wang, H-W, Anovitz, LM, Kolodny, Y, Jackson, AJ, Rother, G, Cole, D, and Stack, AG (2012) Multiscale characterization of pore evolution in a combustion metamorphic complex: Combining (ultra) small-angle neutron scattering and image analysis. 2012 American Crystallographic Association Annual Meeting
- Smith, B, Frame, BJ, and Anovitz, LM (2012) Delivery of Gaseous Hydrogen Using Composite Pipelines. Composites Conference 2012, Las Cruces, NM.
- Unocic, KA, Elsentriecy, HH, Brady, MP, Meyer, HM III, Keiser, JR, Anovitz, LM, Rother, G, Thomson, JK, Fayek, M, Song, G-L, and Davis, B (2013) Characterization of Film Formation on Commercial and Model Magnesium Alloys, TMS meeting, San Antonio, Texas, March, 2013.
- Elsentriecy, HH, Unocic, KA, Brady, MP, Song, G-L, Meyer, HM III, Keiser, JR, Anovitz, LM, Rother, G, Thomson, JK, Fayek, M, and Davis, B (2013) Understanding Protective Film Formation by Magnesium Alloys. TMS Meeting, San Antonio, Texas.
- Anovitz, LM, Fayek, M, Cole, DR, and Carter, T (2012) Hydration of rhyolitic glasses: comparison between high- and low-temperature processes. (Invited) Fall AGU Meeting, San Francisco.
- Anovitz, LM, Wang, HW, Cole, DR, and Rother, G (2012) Effect of rock type and geologic process on the structure and evolution of nano, meso, and micro-scale porosity: a (U)SANS, SEM/BSE analysis (invited) Fall, AGU Meeting, San Francisco

- Elsentriecy, HH, Unocic, KA, Brady, MP, Song, G-L, Meyer, HM III, Keiser, JR, Anovitz, LM, Rother, G, Thomson, JK, Fayek, M, and Davis, B. (2013) Understanding protective film formation by magnesium alloys. TMS 2013, San Antonio.
- Cole, DR, Tokunaga, T, Steefel, CI, Wang, J, Anovitz, LM, Rother, G, Davis, J, Ajo-Franklin, J, and DePaolo, D (2013) Current research on CGS reservoir processes within the center for Nanoscale Control of Geologic CO₂ (NCGC). 12th Annual Conference on Carbon Capture Utilization and Sequestration, May, Pittsburgh, PA.
- Banuelos, JL, Rother, G, Fulvio, PF, Presser, V, Feng, G, Browning, J, Anovitz, LM, Cummings, PT, Dai, S, Gogotski, YG, and Wesolowski, DJ (2012) The behavior of electrolytes at charged carbon electrode interfaces. American Conference on Neutron Scattering, June 24, 2012, Washington, DC.
- Polsky, Y, An, K, Anovitz, LM, Bingham, PR, Carmichael, JR, and Dessieux, LL Jr. (2013) Development of a neutron diffraction-based strain measurement capability for triaxial loading conditions. 47th U.S. Rock Mechanics/Geomechanics Symposium, San Francisco, CA.
- Polsky, Y, Anovitz, LM, Bilheux, HZ, Bingham, PR, and Carmichael, RJ (2013) Application of neutron imaging to investigate flow through fractures for EGS. Stanford Geothermal Workshop, Stanford, CA.
- Wang, H-W, Wesolowski, DJ, Proffen, TE, Kolesnikov, AI, Vlcek, L, Wang, W, Feygenson, M, Sofo, JO, and Anovitz, LM (2012) Investigation of the structure and stability of SnO₂ nanocrystal and its surface-bound water. Workshop for Advanced Simulation Techniques for Total Scattering Data, Santa Fe, NM.
- Wang, H-W, Wesolowski, DJ, Proffen, TE, Kolesnikov, AI, Vlcek, L, Wang, W, Feygenson, M, Sofo, JO and Anovitz, LM (2012) Structure and stability of SnO₂ - nanocrystal and its surface-bound water: Combined investigations using neutron total scattering and inelastic neutron scattering. Fall AGU Meeting.
- Wang, H-W, Anovitz, LM, Allard, LF Jr., Kolodny, Y, Jackson, AJ, Rother, G, Cole, D, and Stack, AG (2012) Multiscale characterization of pore evolution in a combustion metamorphic complex: Combining (ultra) small-angle neutron scattering and image analysis. 2012 American Crystallographic Association Annual Meeting. Boston, MA.
- Smith, B, Frame, BJ, and Anovitz, LM (2012) Delivery of gaseous hydrogen using composite pipelines. Composites Conference 2012, Las Cruces, NM.
- Banuelos, JL, Fulvio, PF, Rother, G, Anovitz, LM and Browning, J (2012) The wetting behavior of electrolytes at charged carbon electrode materials probed using neutron scattering. American Physical Society March Meeting, 2012, Boston, MA.
- Littrell, KC, Anovitz, LM, Feng, ZL, Woo, WC, Coakley, J (2012) Measuring thermal stability of nano-precipitates in advanced high-strength steel using SANS. Small Angle Scattering Conference, Sidney, Australia.
- Anovitz, LM, Cole, DJ, Jackson, A, Rother, G, Littrell, K, and Allard, JF Jr. (2012) (U)SANS analysis of experimental dissolution and formation of quartz overgrowths in St. Peter Sandstone. Goldschmidt conference.
- Rother, G., Ilton, E., Anovitz, LM, Cole, DJ, and Krukowski, EG (2011) Interactions of Supercritical Carbon Dioxide with Porous Silica and Montmorillonite Clay. American Geophysical Union.
- Littrell, KC, Rother, G., Anovitz, LM, Debeer-Schmitt, CLM (2011) In-situ study of kerogen release and metamorphism in oil shale by SANS. 7th International Symposium on Novel Materials and their Synthesis. IUPAC, Shanghai, China, Oct, 2011. Received best poster prize.
- Smith, B, Frame, BJ, and Anovitz, LM (2012) Delivery of Gaseous Hydrogen Using Composite Pipelines. Composites Conference.
- Bingham, P, Anovitz, LM, Polsky, Y (2012) Ultra High Resolution Cold Neutron Imaging of Fluid Flow and Fracture in EGS Environments. Geothermal Technologies Program Review, May, 2012.

- Unocic, KA, Elsentriecy, HH, Brady, MP, Meyer, HM III, Keiser, JR, Anovitz, LM, Rother, G, Thomson, JK, Fayek, M, Song, G-L, and Davis, B. (2013) Characterization of Film Formation on Commercial and Model Magnesium Alloys. TMS Conference, submitted.
- Smith, DB and Anovitz, LM (2012) Lifecycle Verification of Polymeric Storage Liners. DOE Fuel Cell Technology Program Annual Merit Review.
- Smith, DB, Frame, BJ and Anovitz, LM (2012) Composite Pipeline Technology for Hydrogen Delivery. DOE Hydrogen Program Annual Merit Review 2012.
- Banuelos, JL, Fulvio, PF, Rother, G, Anovitz, LM, and Browning, J (2012) The wetting behavior of electrolytes at charges carbon electrode materials probed using neutron scattering. American Physical Society March Meeting, 2012.
- Rother, G, Banuelos, JL, Zhou, H, Fulvio, PF, Feng, G, Anovitz, LM, Dai, S, Cummings, PT, Fenter, P, and Wesolowski, DJ (2012) Structure of RTILs at surfaces and under nano-confinement: scattering and molecular modeling. FIRST Center EFRC review Meeting, Chicago, March, 2012.
- Wesolowski, DJ, Anovitz, LM, Vlcek, L, Rother, G, and Cole, DR (2011) Nanometer to centimeter scale analysis and modeling of pore structures. American Geophysical Union, EOS.
- Rother, G, Krukowski, EG, Anovitz, LM, Ilton, ES, Cole, DR, and Sposito, G (2011) Carbon dioxide interactions with reservoir and cap rocks: a study combining sorption and neutron scattering with MD simulations. American Chemical Society, Fall, 2011, 242, 94-GEOC.
- Anovitz, LM, Vlcek, L, Rother, G, and Cole, DR (2011) Nanometer to centimeter scale analysis and modeling of pore structures in geologic storage formations and caprock. American Chemical Society, Fall, 2011, 242, 50-GEOC.
- Rother, G, Anovitz, LM, Wesolowski, DJ, Cole, DR, and Brantley, SL (2011) Fluid interactions with minerals and rocks – dynamics and evolution from picoseconds to thousands of years. Geochemical Dynamics Symposium, Gaithersburg, MD, Sept, 2011.
- Wei, Z, Feng, Z, Fei, R, Wang, J.-A, and Anovitz, LM (2011) Susceptibility of carbon steel welds to hydrogen embrittlement. FABTECH 2011, AWS Professional Program, Chicago.
- Anovitz, LM and Cole, DR (2011) Nanometer to Centimeter Scale Analysis and Modeling of Pore Structures in Geologic CO₂ Storage Formations and Caprocks. Goldschmidt Conference, .Geochimica et Cosmochimica Acta,
- Zhang, W, Feng, Z, Ren, F, Wang, JA, and Anovitz, LM (2011) Susceptibility of Carbon Steel Welds to Hydrogen Embrittlement. FABTECH 2011 - AWS Professional Program.
- Wang, JA, Ren, F, Zhang, W, Feng, Z, Anovitz, LM, Chen, Z, and Xu, H (2011) Development of in situ techniques for torsion and tension testing in hydrogen environment. ASME Pressure Vessels and Piping Division Conference
- Rother, G, Anovitz, LM, Chialvo, AA, Cole, DR, Gruskiewicz, MS, Vlcek, L, and Sposito, G (2011) Probing CO₂-rich Fluid Interactions with Reservoir Rocks – from Atomic to the Pore Scales. EFRC Summit 2011.
- Cole, DR, Rother, G, Chialvo, AA, Vlcek, L, Gruskiewicz, MS, and Anovitz, LM (2011) Structure and Dynamics of CO₂-bearing Fluids at Nanoscale Interfaces. EFRC Summit 2011.
- Anovitz, LM, Fayek, M, Cole, DR and Carter, T (2011) Analysis of Obsidian Hydration: The Current State of the Art. Soc. Amer. Archaeology.
- Otake, T., Wesolowski, DJ, Anovitz, LM, Allard, LF Jr. and Ohmoto, H (2011) Mechanisms of Iron Oxide Transformations in Hydrothermal Systems. Japanese Geomorphological Union Meeting.

- Anovitz, LM, Rother, G, and Cole, DR. (2011) Characterization of rock pore features in geothermal systems using small angle neutron scattering (SANS). Proc. 36th Workshop On Geothermal Res. Eng., Sgp-Tr-191, 571-582.
- Smith, DB and Anovitz, LM (2011) Lifecycle Verification of Polymeric Storage Liners. DOE Fuel Cell Technology Program Annual Merit Review.
- Smith, DB, Frame, BJ and Anovitz, LM (2011) Composite Technology for Hydrogen Pipelines. DOE Hydrogen Program Annual Merit Review 2011.
- Debeer-Schmitt, LM, Qiu, X, Anovitz, LM, Heller, WT, Littrell, K, Paranthaman, MP (2011) A Study of the Effect of Nitrogen Doping in TiO₂. American Physical Society March Meeting.
- Anovitz, LM (2011) Properties of CO₂-Rich Pore Fluids and Their Effect on Porosity Evolution in EGS Rocks. Geothermal Technologies Program Annual Merit Review.
- Littrell, K, DeBeer-Schmitt, L, Anovitz, LM, Rother, R, and Cole, DR (2010) In-situ study of diagenesis and metamorphism of sedimentary rock by SANS. American Conf. Neutron Scattering. June 26-30, 2010.
- Anovitz LM, Cole DR, Rother G, Valley, JW, and Jackson, A. (2010) Analysis of nano-porosity in the St. Peter Sandstone Using (Ultra) Small Angle Neutron Scattering. *Geochimica et Cosmochimica Acta*, 74 (12), A26-A26, Suppl. 1.
- Cole DR, Labotka TC, Fayek M, Utsunomiya, S., and DeAngelis M (2010) Chemical, isotopic and structural features associated with mineral-fluid systems far from equilibrium. *Geochimica et Cosmochimica Acta*, 74 (12), A185-A185, Suppl. 1.
- Fayek M, Anovitz LM, Cole DR, and Bostick, DA (2010) O and H diffusion in uraninite: Implications for fluid-uraninite interactions and nuclear forensics. *Geochimica et Cosmochimica Acta*, 74 (12), A282-A282, Suppl. 1.
- Mamontov E, Vlcek L, Wesolowski DJ, Cole, DR, Anovitz LM, Wang W, and Cummings PT (2010) Pico- to nano-second dynamics of water on mineral surfaces . *Geochimica et Cosmochimica Acta*, 74 (12), A662-A662, Suppl. 1.
- Smith, DB and Anovitz, LM (2010) Lifecycle Verification of Polymeric Storage Liners. DOE Fuel Cell Technology Program Annual Merit Review.
- Smith, DB, Frame, BJ and Anovitz, LM (2010) Composite Technology for Hydrogen Pipelines. DOE Hydrogen Program Annual Merit Review 2010.
- Feng, Z., Wang, J.-A., Xu, H., and Anovitz, L.M. (2009) Quantifying hydrogen embrittlement of steel welds under high pressure hydrogen. 2009 ASME Pressure Vessels and Piping Conference.
- Feng, Z., Anovitz, L. and Armstrong, T. (2009) High-Pressure Hydrogen Permeation and Diffusion in Iron and Steels. TMS Annual Meeting & Exhibition.
- Anovitz, LM, Fayek, M, Carter, T, Hunter, J. Jr. and Cole, DR (2009) Mechanisms of glass hydration and a preliminary investigation of ODDSIMS dating of obsidian artifacts from Çatalhöyük, Turkey. *Geol. Soc. Am. Abst w./ Prog* 41(7) 554.
- Smith, DB and Anovitz, LM (2009) Lifecycle Verification of Polymeric Storage Liners. DOE Hydrogen Program Annual Merit Review 2009.
- Smith, DB, Frame, BJ and Anovitz, LM (2009) Composite Technology for Hydrogen Pipelines. DOE Hydrogen Program Annual Merit Review 2009.

- Fayek, M., Hull, S., Anovitz, L.M., Haynes, C.V. Jr., and Bergen, L. (2008) Evidence of impact material and the extinction of the megafauna 12,900 years ago. Fall AGU Conference, submitted.
- Fayek, M., Hull, S., Anovitz, L.M., Haynes, C.V. Jr., and Bergen, L. (2008) Extinction of the Mega-Fauna: Petrographic and Chemical Evidence of a Meteorite Impact. Pecos Conference, August, Flagstaff Arizona
- Davis, M.C., Brouwer, W.J., Anovitz, L.M., Wesolowski, D.J., Brantley, S.L., and Mueller, K.T. (2008) NMR investigations of silicate dissolution. American Chemical Society Fall National Meeting (in sub.)
- Anovitz, L.M., Lynn, G.W., Cole, D.R., Rother, R., Allard, L.F., Hamilton, W.A., Porcar, L., and Kim, M.-H. (2008) A new approach to quantification of metamorphism using ultra-small and small angle neutron scattering. Goldschmidt meeting, *Geochimica et Cosmochimica Acta*, 72(12).
- Davis, M., Wesolowski, D., Anovitz, L., Allard, L., Brantley, S., and Mueller, K. (2008) Near equilibrium investigations of quartz and forsterite dissolution. Goldschmidt, *Geochimica et Cosmochimica Acta* 72(12) A202.
- Zhang, Z., Fenter, P., Wesolowski, D., and Anovitz, L. (2008) Probing the cassiterite (110) – water interface structure with X-ray scattering method. Goldschmidt, *Geochimica et Cosmochimica Acta* 72(12) A1091.
- Wesolowski, D.J., Mamontov, E., Vlcek, L., Wang, W., Cummings, P.T. Rosenqvist, J., Anovitz, L.M. and Cole, D.R. (2008) Quasielectric neutron scattering coupled with classical molecular dynamics simulations of water dynamics at metal oxide surfaces. Goldschmidt, *Geochimica et Cosmochimica Acta* 72(12) A1015.
- Feng, Z., Wang, J.-A., Anovitz, L.M. and Armstrong, T.R. (2008) Hydrogen embrittlement of pipeline steel weld under high gaseous hydrogen pressure. International Hydrogen Conference: Effects of Hydrogen on Materials, Jackson Lake Lodge, Wyoming, Sept 7-10, 2008.
- Feng, Z., Anovitz, L.M. and Armstrong, T.R. (2008) High-pressure hydrogen permeation and diffusion in iron and steels. International Hydrogen Conference: Effects of Hydrogen on Materials, Jackson Lake Lodge, Wyoming, Sept 7-10, 2008.
- Feng, Z., Anovitz, L.M. and Armstrong, T.R. (2008) High-pressure hydrogen permeation, diffusion and transport in pipeline steels. Materials Innovations in an Emerging Hydrogen Economy Meeting, Cocoa Beach, Florida, Feb 24-27, 2008, p. 15.
- Feng, Z., Anovitz, L. and Wang, J.-A. (2008) Hydrogen permeability, integrity of welds and HAZ in steel hydrogen pipelines. DOE Hydrogen Pipeline Working Group Meeting. Feb 19-20, 2008.
- Feng, Z., Anovitz, L.M., Kironko, P., Duncan, A., Adams, T., and Sofronis, P., (2007) Permeation, diffusion, solubility measurements, results and issues. DOE Hydrogen Pipeline Working Group Meeting, Center for Hydrogen Research, Aiken, SC, Sept 23-26, 2007
- Smith, B., Frame, B., Anovitz, L., and Eberle, C. (2007) Composite Pipeline R&D. DOE Hydrogen Pipeline Working Group Meeting, Center for Hydrogen Research, Aiken, SC, Sept 23-26, 2007
- Anovitz, L.M., Lynn, G.W., Cole, D.R., Hamilton, W.A., Porcar, L., and Kim, M.-H. (2006) Recrystallization Processes in Natural and Experimental Marbles: SANS and USANS Analysis. *Eos Transactions, American Geophysical Union*, 87 (52) Fall Meeting, Abstract V42A-06
- Labotka, T C , Cole, D.R., Fayek, M., and Anovitz, L.M. (2006) An experimental study of the serpentine cycle: The hydration of dunite. *Eos Transactions, American Geophysical Union*, 87 (52) Fall Meeting, Abstract V32B-05.
- Otake, T, Wesolowski, DJ, Anovitz, LM, Allard, L.F. and Ohmoto, H (2006) Experimental evidence of non-redx transformation between magnetite and hematite under H₂-rich hydrothermal conditions. Geological Society of America Abstracts with Program. Paper 96-13.

- Fayek, M., Anovitz, L.M., Riciputi, L.R., Cole, D.R., Elam, J.M. (2006) A new understanding of obsidian hydration, Abstracts of the Society for American Archaeology 71st annual meeting, P.148.
- Babu, SS, Blencoe, JM, Anovitz, LM, Feng, Z and Korinko, PS (2005) High Pressure Hydrogen Transfer through Steel Pipeline: Issues, Challenges, and Path Forward. Materials Science and Technology '05, 68.
- Anovitz, LM, Riciputi, LR, Cole, DR, Elam, JM, and Gruszkiewicz, MS (2005) The effect of changes in relative humidity on rates of obsidian hydration. 60th Ann. Calorimetry conf. CALCON 2005, 118.
- Hull, S., Fayek, M. and Anovitz, LM (2005) The effects of alteration on sourcing archaeological turquoise. Geological Society of America Abstracts with Program 37(7).
- Anovitz, LM, Riciputi, LR, Cole, DR, and Fayek, M (2005) "Hydration" of rhyolitic glasses: Comparison between high- and low-temperature processes. Mineral Surface Reactivity Session, Goldschmidt Conference, Geochimica et Cosmochimica Acta 69(10), Suppl. S, A492.
- Palmer, DA, Anovitz, LM, Cole, DR, Fayek, M, Gruszkiewicz, MS, Riciputi, LR, Wesolowski, DJ, and Wilson, L (2005) Experimental approaches to predict the behavior of liquid films. Toxic and Radioactive Waste Disposal Session, Goldschmidt Conference, Geochimica et Cosmochimica Acta 69(10), Suppl. S, A413.
- Otake, T, Wesolowski, DJ, Anovitz, LM, Hayashi, K, and Ohmoto, H (2005) Magnetite transformation to hematite under high H₂ pressure at 150 °. Toxic and Radioactive Waste Disposal Session, Goldschmidt Conference, Geochimica et Cosmochimica Acta 69(10), Suppl. S, A425.
- Labotka, TC, DeAngelis, MT, Cole, DR, and Anovitz, LM (unlisted) (2005) Breakdown of dolomite in H₂O-rich fluid: an experimental study. Kinetics and Metamorphic Processes Session, Goldschmidt Conference, Geochimica et Cosmochimica Acta 69(10), Suppl. S, A406.
- DeAngelis, M. T., Labotka, T. C., Cole, D. R., Fayek, M., Anovitz, L. M., Lordo, K. M. (2004) Kinetics of the reaction dolomite = periclase + calcite + CO₂: an experimental investigation of reaction and fluid transport in rock cores. Geological Society of America Abstracts with Program, 36, 5.
- Labotka, T.C., Anovitz, L.M. and Blencoe, J.G. (2004) Activity-composition relations in the system H₂O-CO₂-NaCl at 500 °C, 50 Mpa. Geological Society of America Abstracts with Program. 36, 5.
- Blencoe, J.G., Marshall, S.L. and Anovitz, L.M. (2004) Potential industrial applications of magnesite-producing reactions in future, hydrogen-based global economies. Geological Society of America Abstracts with Program, 36, 5.
- Wesolowski, D.J., Anovitz, L.M., Bénézeth, P., Chialvo, A.A., Palmer, D.A., Fenter, P., Cheng, L., Sturchio, N.C., Zhang, Z., Bedzyk, M.J., Kubicki, J.D., Fedkin, M.V., Lvov, S.N., Sykes, D., Cummings, P.T., Ridley, M.K., Machesky, M.L., Predota, M., Bandura, A.V. (2004) Temperature-effects and structure at the rutile-water interface. Eleventh Annual Symposium on Water Rock Interaction: WRI-11 June 27-July 2, Saratoga Springs, NY.
- Bénézeth, P., Palmer, D.A., Anovitz, L.M., Wesolowski, D.J. and Blencoe, J.G. (2004) Investigations of dawsonite-forming reactions for geological CO₂ sequestration. Eleventh Annual Symposium on Water Rock Interaction: WRI-11 June 27-July 2, Saratoga Springs, NY.
- Blencoe, J.G., Marshall, S.L., Naney, M.T. and Anovitz, L.M. (2004) The Significance of Mixed-Volatile (CO₂-CH₄) Densities, Viscosities and Vapor-Liquid Equilibria in CO₂-Enhanced Coalbed Methane Production. 3rd Ann. Conf. on C-Sequestration, May 2004.
- Blencoe, J.G., Anovitz, L.M., Palmer, D., and Beard, J. (2004) Carbonation of Serpentine for Safe, Effective and Permanent CO₂ Sequestration. 3rd Ann. Conf. On C-Sequestration, May 2004.
- DeAngelis, MT, Labotka, T C, Anovitz, LM, Cole, DR, and Fayek, M (2003) Experimental Investigation of Reaction and Fluid Transport in Dolomite Rock. American Geophysical Union, Eos. (best poster award)

- Blencoe, J.G., Naney, M.T. and Anovitz, L.M. (2003) A Special Autoclave Apparatus for Measuring Coal/Gas Properties and Interactions at Elevated Temperatures and Pressures. 2nd Ann. Conf. On C-Sequestration, May 2003.
- Wesolowski, D.J., Chialvo, A., Bénézeth, P., Palmer, D.A., Gu., B., Hamilton, W.A., Wang W., Anovitz, L.M., Fenter, P.A., Sturchio, N.C., Zhang, Z., Cheng, L., Bedzyk, M.J., Machesky, M.L. Ridley, M.K. Cummings, P.T., Predota, M., Lvov, S.N., Kubicki, J.D., Zhou, X.X., Fedkin, M.V. and Bandura, A.V. (2003) Nanoscale Complexity at the Oxide-Water Interface. DOE Surface Geochemistry Workshop, Argonne National Laboratory, March, 2003.
- Anovitz, L.M., Elam, J.M., Riciputi, L.R. and Cole, D.R. (2002) Hydration of Pachuca obsidian: implications for ODDSIMS archaeochronometry. *Geol. Soc. Amer. Abst.* 34, 6, 184.
- Anovitz, L.M., Labotka, T.C., and Blencoe, J.G. (2002) Experimental determination of phase equilibria in the system H₂O-CO₂-NaCl at 0.5 kb from 500 to 700°C. *Geol. Soc. Amer. Abst.*, 34, 6, 363.
- Anovitz, L.M., Wesolowski, D.J. Machesky, M.L. and Bénézeth, P. (2002) Preparation of solid oxide materials for surface studies. Abstracts Of Papers Of The American Chemical Society 223: 135-Geoc Part 1 Apr 7 2002.
- Palmer, D.A., Wesolowski, D.J., Anovitz, L.M. and Machesky, M.L. (2002) Surface Charge and pH_{zpc} of Zirconium Oxide from Potentiometric Titration Measurements at 25-290°C in Sodium Chloride Solutions. Abstracts Of Papers Of The American Chemical Society 223: 117-Geoc Part 1 Apr 7 2002.
- Wesolowski, D.J., Bénézeth, P., Zhang, Z., Fenter, P., Machesky, M.L. Palmer, D.A., Ridley, M.K. and Anovitz, L.M. (2002) Sorption of zinc on rutile surfaces in sodium triflate solutions at elevated temperatures. Abstracts Of Papers Of The American Chemical Society 223: 116-Geoc Part 1 Apr 7 2002
- Zhang, Z., Fenter, P., Cheng, L., Sturchio, N.C. Bedzyk, M.J. Machesky, M.L. Anovitz, L.M. and Wesolowski, D.J. (2002) Condensed Layer Ion Positions at the Rutile-Water Interface with High Brilliance X-rays. American Geophysical Union, Eos.
- Zhang, Z., Fenter, P., Cheng, L., Sturchio, N.C. Bedzyk, M.J. Machesky, M.L. Anovitz, L.M. and Wesolowski, D.J. (2002) Probing the ion distribution at rutile/aqueous interface with high brilliance X-rays. Abstracts Of Papers Of The American Chemical Society 223: 102-Geoc Part 1 Apr 7 2002
- Machesky, M.L. Wesolowski, D.J., Ridley, M.K., Palmer, D.A. and Anovitz, L.M. (2001) Ion adsorption properties of metal oxide surfaces under hydrothermal conditions. Abstracts Of Papers Of The American Chemical Society 222: 18-Geoc Part 1 August 2001.
- Anovitz, L.M., Elam, J.M., Riciputi, L.R. and Cole, D.R. (2001) Determination of the rate of "H₂O" diffusion from 30 to 150°C in obsidian from the Pachuca source, Sierra de las Navajas, Mexico. *Geol. Soc. Amer. Abst.* A238.
- Blencoe, J.G., Anovitz, L.M., Singh, J. and Seitz, J.C. (2001) Relative bouyancies of CO₂-H₂O mixtures at 300-400°C and pressures to 100 megapascals. *Geol. Soc. Amer. Abst.* A17.
- Blencoe, J.G., Naney, M.T. and Anovitz, L.M. (2001) A new experimental method for determining liquid-vapor equilibria in the CO₂-H₂O system at high subcritical temperatures. *Eleventh annual V.M. Goldschmidt Conference.*
- Wesolowski, D.J., Machesky, M.L., Ziemniak, S.E., Xiao, C., Palmer, D.A., Anovitz, L.M. and Bénézeth, P. (2001) Solubility and surface adsorption characteristics of metal oxides to high temperature. *Eleventh annual V.M. Goldschmidt Conference.*
- Riciputi, L.R., Elam, J.M. Anovitz, L.M. and Cole, D.R. (2000) Diffusion dating of obsidian artifacts by secondary ion mass spectrometry at Chalco, Mexico. *Geol. Soc. Amer. Abst.* A275.
- Blencoe, J.G., Anovitz, L.M. and Naney, M.T. (2000) The partial molar volume of water in magmatic silicate melts. *Geol. Soc. Amer. Abst.* A434.
- Anovitz, L.M., Labotka, T.C., Blencoe, J.G. (2000) Experimental determination of phase equilibria in the system H₂O-CO₂-NaCl at 0.5 kb from 500 to 800°C. *Geol. Soc. Amer. Abst.* A151.
- Wesolowski, D.J., Palmer, D.A., Machesky, M.L., Anovitz, L.M., Hyde, K.E., and Hayashi, K.-I. (1999) Solubility and

surface charge characteristics of magnetite in hydrothermal systems. *13th International Conference on the Properties of Water and Steam*, Toronto, Canada September 12-16, 1999, 142.

- Anovitz, L.M., Labotka, T.C., Blencoe, J.G., Singh, J. and Horita, J. (1999) Experimental determination of the activity-composition relations and phase equilibria of H₂O-CO₂-NaCl fluids. *13th International Conference on the Properties of Water and Steam*, Toronto, Canada September 12-16, 1999, 171.
- Singh, J., Blencoe, J.G. and Anovitz, L.M. (1999) Volumetric properties and phase relations of binary H₂O-CO₂-CH₄-N₂ mixtures at 300°C and pressures to 1000 bars. *13th International Conference on the Properties of Water and Steam*, Toronto, Canada September 12-16, 1999, 161.
- Blencoe, J.G., Anovitz, L.M., Singh, J. and Naney, M.T. (1999) A two-parameter excess pressure equation for H₂O-CO₂ fluids at 400°C, 10-100 MPa. *13th International Conference on the Properties of Water and Steam*, Toronto, Canada September 12-16, 1999, 160.
- Wesolowski, D.J., Machesky, M.L., Palmer, D.A. and Anovitz, L.M. (1999) Magnetite surface protonation to 290°C from acid/base titrations with in situ pH measurement. *Ninth annual V.M. Goldschmidt Conference*, Abstr. # 7071. LPI Contribution No. 971, Lunar and Planetary Institute, Houston (CD_ROM).
- Wood, S.A., Anovitz, L.M., Elam, J.M., Cole, D.R., Riciputi, L.R. and Benezeth, P. (1999) The effect of fulvic acid on the extent and rate of dissolution of obsidian. *Ninth annual V.M. Goldschmidt Conference*, Abstr. # 7191. LPI Contribution No. 971, Lunar and Planetary Institute, Houston (CD_ROM).
- Anovitz, L.M., Allard, L.F., Porter, W.D., Coffey, D.W., Benezeth, P., Palmer, D.A. and Wesolowski, D.J. (1999) Microstructural characterization of water-rich boehmite (AlO(OH)): correlation of apparently divergent XRD and TGA results. *Microscopy and Microanalysis, Proceedings of Microscopy and Microanalysis '99*, Vol 5, Suppl. 2, 540-541.
- Blencoe, J.G., Anovitz, L.M. Singh, J. and Seitz, J.C. (1999) A modified virial equation of state for binary mixed-volatile fluids. *Geol. Soc. Amer. Abst.* A354.
- Anovitz, L.M. and Blencoe, J.G. (1999) Experimental determination of the compositions of aqueous fluids coexisting with silicate melts. *Geol. Soc. Amer. Abst.* A354.
- Elam, J.M., Anovitz, L.M., Riciputi, L.R., and Cole, D.R. (1998) Dating obsidian artifacts by SIMS. Workshop: Obsidian Hydration I: Fundamentals of Dating and Sourcing, *Society for American Archaeology* Abstr. 63, 9.
- Blencoe, J.G., and Anovitz, L.M., Seitz, J.C. (1998) A new method for modeling the thermodynamic mixing properties of high-temperature H₂O-CO₂ fluids. *Eos*.
- Blencoe, J.G., and Anovitz, L.M., Seitz, J.C. (1998) A Helmholtz free energy model for supercritical H₂O-CO₂ mixtures. *Geol. Soc. Amer. Abst.* 30, 319.
- Anovitz, L.M. Labotka, T.C., Blencoe, J.G. and Singh, J. (1998) Activity-composition and phase relations of H₂O-CO₂-NaCl fluids at 500°C, 500 bars. *Geol. Soc. Amer. Abst.* 30, 319.
- Labotka, T.C., Anovitz, L.M., Blencoe, J.G. and Seitz, J.C. (1998) The effects of the mixing properties of H₂O-CO₂ on the flow of metamorphic fluids. *Geol. Soc. Amer. Abst.* 30, 319.
- Anovitz, L.M., Elam, J.M., Riciputi, L.R., and Nolan, T. (1997) Diffusion revisited: the myth of obsidian hydration dating. *Society for American Archaeology*.
- Anovitz, L.M., Blencoe, J.G., and Horita, J. (1997) Precise measurement of the activity/composition relations of H₂O-N₂ and H₂O-CO₂ fluids at 500°C, 500 bars. *Fifth International Symposium on Hydrothermal Reactions*, 232.
- Blencoe, J.G., Seitz, J.C., and Anovitz, L.M. (1997) Excess free energies and activity-composition relations for H₂O-CO₂ fluids at 400°C and 1-4000 bars. *Fifth International Symposium on Hydrothermal Reactions*, 113-116.
- Blencoe, J.G., Anovitz, L.M., and Seitz, J.C. (1997) A fundamental flaw in modified Redlich-Kwong equations for supercritical H₂O-CO₂ fluids. *Eos* 78, S335.
- Anovitz, L.M. and Blencoe, J.G. (1997) Re-analysis of the albite-water system. *Eos* 78, S335-6.
- Palmer, D.A., Bénézech, P., Wesolowski, D.J., Anovitz, L.M., Machesky, M.L., Hayashi, K.-I., and Hyde, K.E. (1997)

Solubility of, and hydrogen ion adsorption on, some metal oxides in aqueous solutions to high temperatures. *Fifth International Conference on Cycle Chemistry in Fossil Plants, EPRI*.

- Anovitz, L.M. and Blencoe, J.G. (1997) Experimental determination of the compositions of aqueous fluids coexisting with silicate melts. *Geol. Soc. Amer. Abst.* 29, A394.
- Blencoe, J.G., Anovitz, L.M., and Seitz, J.C. (1997) Serious shortcomings of semi-empirical equations of state for high-temperature aqueous C-O-H-N fluids. *Geol. Soc. Amer. Abst.* A210.
- Anovitz, L.M., Benezeth, P., Blencoe, J.G., Cole, D.R., Gruskiewicz, M.S., Horita, J., Joyce, D.B., Mesmer, R.E., Palmer, D.A., Simonson, J.M. and Wesolowski, D.J. (1996) Overview of fundamental geochemistry basic research at the Oak Ridge National Laboratory. In: *Keeping Geothermal Energy Competitive in Foreign and Domestic markets, Dept. of Energy Geothermal Program Review XIV*, Berkeley, CA, April 8-10, 1996.
- Blencoe, J.G., Seitz, J.C., Anovitz, L.M., and Joyce, D.B. (1996) Thermodynamic mixing properties of C-O-H-N fluids at high pressures and temperatures. In: *Reactivity and mobility of geologic fluids: Constraints from inorganic geochemistry. Geosciences Research Program ER-15, Department of Energy Office of Basic Energy Sciences*, 10.
- Blencoe, J.G., Anovitz, L.M., Joyce, D.B., and Beard, J.S. (1996) Experimental calibration of the Ni-NiO-H₂O hydrogen buffer at 500°C, 500 bars. *Geol. Soc. Amer. Abst.* 28, A159.
- Anovitz, L.M., Blencoe, J.G., Joyce, D.B., and Horita, J. (1996) Activity/composition relations of H₂O-N₂ and H₂O-CO₂ fluids at 500°C, 500 bars. *Geol. Soc. Amer. Abst.* 28, A159.
- Anovitz, L. M., Blencoe, J. G., Horita, J., and Cole, D. R. (1995) An Experimental Method for Determining Compositions of Aqueous Fluids Coexisting with Silicate Melts. In: *Third Hutton Symposium, The Origin of Granites and Related Rocks. United States Geological Survey Circular 1129*.
- Blencoe, J.G. and Anovitz, L.M. (1995) Methods for determining the thermodynamic mixing properties of hydrous haplogranitic melts: Progress, problems and prospects. In: *Third Hutton Symposium, The Origin of Granites and Related Rocks. United States Geological Survey Circular 1129*.
- Anovitz, L.M., Joyce, D.B., Horita, J., and Blencoe, J.G. (1995) New, ultra-precise data on activity composition relations for H₂O/N₂ and H₂O/CO₂ fluids. *Geol. Soc. Amer. Abst.* 27, A431.
- Mazdab, F.K., Anovitz, L.M., Hemingway, B.S. and Navrotsky, A. (1994) New borate and borosilicate thermodynamic data, and an overview of boron mineral assemblages. *Geol. Soc. Amer. Abst.* 26, A448.
- Anovitz, L.M., Blencoe, J.G., Joyce, D.B. and Burch, T.E. (1994) Thermodynamic re-analysis of the dry fusion of albite. *Trans, Amer. Geophys. Union, Eos* 75, 693.
- Blencoe, J.G. Anovitz, L.M., Joyce, D.B. and Burch, T.E. (1994) A new thermodynamic model for albite-water melts. *Trans, Amer. Geophys. Union, Eos* 75, 693.
- Bhattacharyya, S.K. and Anovitz, L.M. (1993) Measurement of the Gibbs free energies of some metal oxide reactions. *Geol. Soc. Amer. Abst.* 25, A94.
- Anovitz, L.M. (1992) On the reliability of Grenville P-T paths. *Geol. Soc. Amer. Abst., South - Central Section*.
- Anovitz, L.M., Kalin, R.M. and Ruiz, J. (1992) Constraints on fluids and mass transfer during high-temperature contact metamorphism: Marble Canyon west Texas. *Geol. Soc. Amer. Abst.* 24, A263.
- Mazdab, F. K., Anovitz, L.M., Hemingway, B.S., Robie, R.A. and Navrotsky, A. (1992) Thermodynamic properties of some boron-bearing minerals. *Geol. Soc. Amer. Abst.* 24, A258.
- Bykerk-Kaufman, A. and Anovitz, L.M. (1991) Thermobarometric evidence for major Laramide crustal thickening in the Catalina - Rincon complex. *Geol. Soc. Amer. Abst., Cordilleran Section*.
- Mottana, A., Paris, E., Davoli, I., and Anovitz, L.M. (1991) Determining Fe-Mg intersite distribution in natural and heated orthopyroxenes by synchrotron X-ray absorption spectroscopy. Presented to the Italian Academy of Sciences May 14, 1991. *Rend. Fis. Acc. Lincei*, 9 (2).
- Anovitz, L.M., Kalin, R.M. and Ruiz, J. (1991) High-temperature contact metamorphism: Marble Canyon west Texas. *GSA Abst. w. Prog., Mineralogical Society of America Symposium. Contact Metamorphism*, 23, A50.

- Anovitz, L.M., and Essene, E.J. (1990) Constraints on the pressure-temperature-time history of the Grenville Province, Ontario. *Geol. Soc. Amer. Abst., Northeastern Section* 22(2), 3.
- Drake, M.J., Anovitz, L.M., and Teska, T.M. (1990) Cameca SX-50 Scanning Electron Microprobe. *Signature Research Materials Characterization Symposium, Tucson, AZ.*
- Anovitz, L.M. (1990) A re-evaluation of activity/composition relations on the join diopside - enstatite. *GSA Abst. w. Prog. Mineralogical Society of America Symposium. Mineral Solid Solutions: Thermodynamics and Petrological Applications*, 22, A70.
- Anovitz, L.M. and Kalin, R.M. (1990) High-temperature metamorphism around the Marble Canyon intrusion, west Texas. *Geol. Soc. Amer. Abst.* 22, A258.
- Mottana, A., Paris, E., Davoli, I. and Anovitz, L.M. (1990) Fe²⁺ - Mg²⁺ order - disorder in natural and heated orthopyroxenes: determination by synchrotron X-ray absorption spectroscopy. *Trans. Amer. Geophys. Union, Eos*, 71, 1621.
- McClelland, W.C., Samson, S., Gehrels, G.E., Patchett, P.J., and Anovitz, L.M. (1989) Tectonic evolution of the Alexander-Stikine terrane suture zone, southeast Alaska. *Geol. Assoc. Canada Roundup.*
- McClelland, W.C., Samson, S., Gehrels, G.E., Patchett, P.J., and Anovitz, L.M. (1989) Structural evolution of the Taku terrane, central southeast Alaska. *1989 Cordilleran Tectonics Workshop.*
- McClelland, W.C., Samson, S., Gehrels, G.E., Patchett, P.J., and Anovitz, L.M. (1989) Structural evolution of the Taku terrane, central southeast Alaska. *Geol. Soc. Amer. Abst., Cordilleran Section* 21, 114.
- McClelland, W.C., Anovitz, L.M., and Gehrels, G.E. (1989) The western margin of the Coast Mountains Batholith: Thermobarometric constraints on its structural evolution, Peterburg Region, SE Alaska. *Geol. Soc. Amer. Abst.* 21(6), A181.
- Anovitz, L.M. (1989) Al-zoning in pyroxenes: Window on prograde granulite P/T paths. *Geol. Soc. Amer. Abst.* 21, A183.
- Gonzales, L.A., Carpenter, S.J., Lohmann, K.C., and Anovitz, L.M. (1989) Inorganic calcite morphology: roles of fluid chemistry and fluid flow. *Geol. Soc. Amer. Abst.* 21, A16.
- Anovitz, L.M., Cosca, M.A., Essene, E.J., and Moecher, D.P. (1988) Pressure and temperature history of Ontario Grenville granulites. *Friends of the Grenville, Grenville Workshop Abst.*, 1.
- Anovitz, L.M., Essene, E.J., Hemingway, B.S., Komada, N.L., and Westrum, E.F., Jr. (1988) The heat-capacities of grunerite and deerite: Phase equilibrium in the system Fe-Si-C-O-H and implications for the metamorphism of banded iron formations. *Eos* 69, 515.
- McClelland, W.C., Anovitz, L.M., and Gehrels, G.E. (1988) Pressure-temperature constraints on metamorphism in the Taku terrane, Petersburg region, southeastern Alaska. *Eos* 69, 479.
- Anovitz, L.M., and Chase, C.G. (1988) P/T paths in Grenville granulites: Implications of flexural isostasy and underplating. *Geol. Soc. Amer. Abst.* 20, A343.
- Anovitz, L.M., Hemingway, B.S., and Robie, R.A. (1988) The thermodynamic properties of dumortierite (Si₃B(Al_{6.75}[_{10.25})O_{17.25}(OH)_{0.75}). *Eos* 69, 1506.
- Anovitz, L.M., and Essene, E.J. (1987) Constraints from garnet zoning on retrograde P-T-t paths in the Grenville Province, Ontario. *Eos* 68, 452.
- Anovitz, L.M., and Essene, E.J. (1986) Thermobarometry in the Grenville Province, Ontario. *Geol. Assoc. Canada / Mineral. Assoc. Canada Abst.* 11, 41.
- Anovitz, L.M., Essene, E.J., and Dunham, W.R. (1986). An experimental study of order-disorder in orthopyroxenes: Implications for pyroxene speedometry. *Geol. Soc. Amer. Abst.* 18, 527-528.
- Anovitz, L.M., and Essene, E.J. (1985) Metamorphism in the Grenville Province, Ontario. *Eos* 66, 385-386.

- Anovitz, L.M., and Essene, E.J. (1985) Intercomparison of garnet barometers and implications for garnet mixing models. *Geol. Soc. Amer. Abst.* 17.
- Anovitz, L.M., Treiman, A.H., Hemingway, B.S., Essene, E.J., Westrum, E.F., Jr., and Wall, V.J. (1984) Thermodynamics and phase equilibria in the system Fe-Ti-O. *Eos* 65, 307.
- Anovitz, L.M., and Essene, E.J. (1983) Reactions with fluorides in the system Na-Fe-Al-Si-O-F. *Eos* 64, 350.
- Bohlen, S.R., Metz, G.W., Essene, E.J., Anovitz, L.M., and Westrum, E.F., Jr. (1983) Thermodynamics and phase equilibria of ferrosilite: Potential oxygen barometer in metamorphic rocks. *Eos* 64, 350.
- Henderson, C.E., Essene, E.J., Anovitz, L.M., Westrum, E.F., Jr., Hemingway, B.S., and Bowman, J.R. (1983) Thermodynamics and phase equilibria of clinocllore (Mg₅Al)(Si₃Al)O₁₀(OH)₈. *Eos* 64, 680.
- Metz, G.W., Anovitz, L.M., Essene, E.J., Bohlen, S.R., Westrum, E.F., Jr., and Wall, V.J. (1983) The heat-capacity and phase equilibria of almandine. *Eos* 64, 346-347.
- Sharp, Z.D., Metz, G.W., Anovitz, L.M., Essene, E.J., Westrum, E.F., Jr., Valley, J.W., and Hemingway, B.S. (1983) The heat-capacity and phase equilibria of monticellite. *Eos* 64, 680.
- Yau, L.Y.C., Anovitz, L.M., Essene, E.J., and Peacor, D.R. (1983) Retrograde reactions in the Marble Formation, Franklin, N.J.: A petrologic and AEM-TEM study. *Geol. Soc. Amer. Abst.* 15, 724.
- Anovitz, L.M., and Essene, E.J. (1982) Phase equilibria in the system CaCO₃-MgCO₃-FeCO₃. *Eos* 63, 464.
- Anovitz, L.M., and Essene, E.J. (1982) Phase equilibria in the system Fe-Al-Si-O-H. *Geol. Soc. Amer. Abst.* 14, 527.
- Anovitz, L.M., and Essene, E.J. (1981) Metamorphism of sideritic iron-formations. *Geol. Soc. Amer. Abst.* 13, 397.

In Preparation

- Davis, M.C., Brouwer, W.J., Mueller, K.T., Anovitz, L.M., and Cole, D.R. Identification of multiple aluminum sites in hydrated albite glasses with ²⁷Al MAS and MQMAS NMR,
- Anovitz, L.M., Elam, J.M. Riciputi, L.R. and Cole, D.R. Determination of the Rate of H₂O Diffusion from 30 to 150°C in Obsidian from the Pachuca Source, Sierra de las Navajas, Mexico. *Phys. Rev. B*
- Riciputi, L.R., Ambrose, W.R., Anovitz, L.M., Elam, J.M., Stevenson, C. SIMS analysis of Wekwok obsidian hydrated under ambient conditions: implications for temperature dependence of obsidian hydration rates. *J. Archaeological Sci.*
- Anovitz, L.M., Mazdab, F.K. and Hemingway, B.S. Heat capacities and derived thermodynamic functions for several borosilicate and borate minerals. *Geochim. Cosmochim. Acta.*
- Anovitz, L.M., Labotka, T.C., Blencoe, J.G., Singh, J. and Horita, J. Experimental determination of the activity-composition relations and phase equilibria of H₂O-CO₂-NaCl fluids. *Geochim. Cosmochim. Acta.*
- Anovitz, L.M. High-temperature contact metamorphism at Marble Canyon, west Texas. *J. Petrology.*
- Anovitz, L.M. A re-evaluation of activity/composition relations on the join diopside-enstatite. *Amer. Mineral.*
- Anovitz, L.M., Bohlen, S.R., Essene, E.J. Hemingway, B.S., Westrum, E.J. The heat capacities and stability relations of ferrosilite and fayalite. *Geochim. Cosmochim. Acta*
- Anovitz, L.M. An unusual occurrence of djerfisherite and rasvumite, Marble Canyon, west Texas. *Amer. Mineral.*

Theme Sessions Organized

- Boron: Mineralogy, Petrology, and Geochemistry in the Earth's Crust. Part 1. (1994) Annual Meeting of the Geological Society of America. Geological Society of America Abstracts with Program 26, T30, A447 - A450.

Boron: Mineralogy, Petrology, and Geochemistry in the Earth's Crust. Part 2. (1994) Annual Meeting of the Geological Society of America. Geological Society of America Abstracts with Program 26, T30, A516 - A517.

Reports on my research

Walli, R.A. (2006) Geology – New olds detectives. Oak Ridge National laboratory July 2006 story tips. http://www.ornl.gov/info/press_releases/get_story_tip.cfm?ID=65

Yeager, A. (2006) Scientists use obsidian for temperatures. The Daily Beacon, Tuesday, Sept 5, 2006.

Perkins, S. (2006) Obsidian artifacts can record ancient climate. Science News 170 (7), 110.

Millwood, Eva (2005) ORNL researchers continue quest to determine age of ancient obsidian. Oak Ridge National Laboratory Reporter 70, 1,4.

Cole, D.R., Wesolowski, D.J., Blencoe, J.G., Horita, J., Riciputi, L.R., Fayek, M., Anovitz, L.M. and Brooks, S. (2005) Geochemistry at U. S. National Laboratories: Oak Ridge National Laboratory. The Geochemical News, 122, 18-33.

Reese, K.M. (2000) More accurate way to date ancient obsidian tools. *Chemical and Engineering News*, April 24, 2000. Page 80.

Perspectives (2000) Scientists search for a date. *Chemistry in Britain*, January, 2000.

Cabbage, Bill (2000) Ancient artifacts: ODDSIMS may reveal just how old. *DOE Pulse*, April 28, 2000.

Brass, Larisa (1999) High-tech dating for ancient history. *The Oak Ridger*, December 14, 1999, 1B. (reprinted with printing corrections, December 15, 1999).

Dye, Lee (1999) Dating timeless obsidian: new technique may pinpoint dates, even climate. <http://abcnews.go.com/sections/scitech/dyehard/dyendex.html> , November 22, 1999. The ABC News site does not maintain archives. The article can be seen at <http://sagitta.ci.uc.pt/mhonarchive/archport/msg00471.html>

Cabbage, Bill (1999) The obsidian clock: ORNL method chips away barriers to dating prehistoric human artifacts. *ORNL Reporter*, 1999 (7), 1,6.