

Adam H. Love, Ph.D. Principal Scientist, Litigation Practice Group Leader *Page 1 of 4*

Technical Specialties:

Dr. Love leads Roux Associates' Litigation Practice Group and provides forensic litigation support and expert witness services to clients throughout the United States on both environmental litigation and environmental insurance coverage related matters. Dr. Love's experience includes strategic and technical analysis and guidance regarding numerous complex groundwater, soil, sediment, soil vapor and air contaminated sites. He has also provided expert technical guidance for state legislative actions and federal advisory panels on a range of traditional and non-traditional environmental hazards. Dr. Love's expertise has been developed through a unique variety of University, Federal and post-academia work, including developing leading edge methods for addressing forensic questions related to weapons of mass destruction for the Federal Government.

Dr. Love's areas of expertise include:

- Environmental forensics (identifying sources and timing of chemical releases);
- Chemical/isotopic fingerprinting;
- Contaminant transport/fate in sediments, soils, water, groundwater, and air;
- Divisibility and apportionment of contamination among PRPs;
- Assessments of petroleum (crude oil, diesel, and gasoline), chlorinated and other solvents (PCE, TCE, TCA, 1,4-dioxane), pesticides, PCBs, radionuclides and heavy metals;
- Environmental site characterization, chemistry, and remediation;
- Human exposure assessment (i.e. Prop 65); and,
- Environmental data analysis.

Dr. Love's capabilities include the use of advanced models and analytic methods to understand and interpret contaminant characterization, transport, and fate for a range of applications. By employing multiple lines of scientific evidence through analyses that couple field measurements, fate and transport calculations, and historical operations/documents, he provides internally consistent opinions and results. Dr. Love is experienced at creating and evaluating Site Conceptual Models based on an understanding of environmental and engineered systems that involve a wide range of matrices (i.e. soils, sorbents, air, natural waters, constructed materials, and biological tissue).

Credentials:

Post Doctorate, Forensic Science Center, Lawrence Livermore National Laboratory, 2004;

Ph.D., Environmental Engineering, University of California at Berkeley, Berkeley, CA, 2002;

M.S., Material Science and Mineral Engineering - Hydrogeology, University of California at Berkeley, Berkeley, CA, 1998; and,

B.A., Geoscience, Franklin & Marshall College, Lancaster, PA, 1996.

Appearances and Expert Reports

- Lewis v. Russell, United States District Court, Eastern District of California. Case No. CIV. S-03-02646 WBS AC. Deposition July 20, 2016. Expert Report. Rebuttal Report. Supplemental Report.
- Goldberg vs. Arns et al., United States District Court, Central District of California. Case No. 94-3834RMT(Shx)860. Deposition May 25, 2016. Expert Report. Rebuttal Report.
- Kaiser, LLC vs. Green's Cleaners, Inc., Napa County Superior Court. Case No: 26-63995. Deposition January 11, 2016. MSJ Declaration.

- State of Colorado, et al., v. Valero Energy Corporation, et al., District Court, City and County of Denver, Colorado. Expert Report. Rebuttal Report.
- Union Oil Consolidated Coverage Cases, Los Angeles Superior Court. Case No: BC 271474. Deposition November 20, 2014. Expert Report.
- Donegan vs. Stubblefield, Rene C. Davidson Alameda County Courthouse. RG12628426. Deposition July 26, 2013. Trial August 8, 2013.
- Searles Valley Minerals Operations Inc. vs. Advanced Steel Recovery Inc. et al., California Ninth District. Central District Court. 5:2010cv01403. Deposition January 25, 2012. Expert Report. Rebuttal Report.

Experience Summary:

20+ years of experience in environmental science/engineering, use of forensic signatures to determine source and timing of contamination, and contaminant assessment, transport and remediation.

- Principal Scientist, 2013-Present and Litigation Practice Group Leader 2016-Present. Roux Associates Inc.
- Principal Scientist, Environmental Forensics Practice Leader Johnson Wright Inc., 2009-2013.
- Principal Investigator/Scientist, Forensic Science Center, Lawrence Livermore National Laboratory, 2002-2009.
- Standards and Technology Unit Staff, California Department of Health Services - Drinking Water Program/Technical Programs Branch, 2000-2002.
- Graduate Student Researcher/Instructor, University of California, Berkeley, 1996-2002.
- Undergraduate Researcher/Laboratory Teaching Assistant, Franklin & Marshall College, 1994-1996.

Example Projects:

Sediment Contamination Reconstruction

Fox River Superfund Site, WI - Expert Witness. Prepared an Expert Report evaluating the technical bases for a range of methodologies used to allocate contribution of polychlorinated biphenyls (PCB) to contaminated sediments. Performed fate and transport analyses as the basis for allocation to estimate mass contributions from various PRPs.

Kalamazoo River Superfund Site, MI - Evaluated the annual total suspended solid (TSS) discharges from 14 facilities to the Kalamazoo River sediments over the 25+ year relevant period of applicable discharges. Allocated TSS discharges to generator facility when secondary facility was used for wastewater treatment. Evaluated changes in facility TSS treatment efficiency and relative TSS contributions throughout the relevant period.

Passaic River (Diamond Alkali) Superfund Site, NJ - Evaluated available historical data, performed fate and transport analyses, and developed a detailed understanding of facility operations to support the facility designation of *de minimis* status.

Gowanus Canal Superfund Site, NY - Evaluated available historical data, performed fate and transport analyses, and developed a detailed understanding of facility operations to support the facility designation of *de minimis* status.

San Diego Harbor, CA - Expert Witness. Evaluated available historical data, performed fate and transport analyses, and developed a detailed understanding of facility operations to support an Expert Report that evaluated potential metals, PCBs, and petroleum releases from the Silvergate Power Plant.

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Naval Air Station Alameda, CA – Collected sediment cores and performed isotopic and chemical analyses that enabled reconstruction of historical sediment contamination.

Petroleum

Avila Beach, CA – Expert Witness. Prepared an Expert Report assessing the release of gasoline, diesel fuel, and crude oil over 50+ years into the soil and sediment. Identified the source and timing of the historical contamination and the nature of the releases using multiple lines of scientific forensic techniques. Performed fate, transport and degradation analysis of gasoline, diesel fuel, and crude oil to determine the divisibility of “sudden and accidental” releases from frequent releases related to facility operations.

Colorado - Expert Witness. Performed fate, transport and degradation analysis of gasoline to determine the timing of gasoline releases. Prepared an Expert Report regarding the release of gasoline from 80+ fueling facilities.

Refinery, CA – Performed evaluation of timing of release and source of contamination related to refinery operations.

Timing of Petroleum Release, Numerous States - Performed fate, transport and degradation analysis of gasoline and fuel oil to determine the timing of releases at 200+ gasoline station and fuel oil sites.

Industrial

Manufacturing Facilities, CA - Provided litigation support based on fate and transport analysis related to timing of groundwater contamination resulting from multiple potential PCE, TCE, TCA and 1,4-dioxane releases to groundwater managed by Orange County Water District. Additional chemical fingerprinting analysis was performed to distinguish on-site versus off-site contributions of chlorinated solvents and their degradation products to the associated groundwater plumes.

Industrial Facility, AZ - Provided litigation support based on fate and transport analysis related to source and timing of groundwater contamination resulting from potential PCE, TCE, and TCA sources.

Aerospace Facility, CA - Evaluated available historical data, performed fate and transport analyses, and developed a detailed understanding of facility operations that provide the technical basis for assessing contribution of PCE, TCE, and TCA from various operations.

Former Military Facility, CA - Performed site investigation of a former military site to determine the extent and magnitude of historical solvents and petroleum releases in order to inform remedial strategy.

Drycleaners

Santa Barbara, CA – Expert Witness. Prepared an Expert Report assessing sources of PCE contamination to soil and groundwater contamination, including drycleaner discharges into sewer system and releases at adjacent sites. Rebuttal Expert Report also assessed the expected remedial costs for PCE contamination at and emanating from the site.

Napa, CA – Expert Witness. Prepared an Expert Declaration regarding the potential sources of PCE contamination to soil and groundwater contamination.

Davis, CA – Expert Witness. Prepared an Expert Report regarding the potential sources of PCE contamination of groundwater.

Numerous Sites, USA – Evaluation of the source, timing, and/or contribution from multiple PRPs to comingled PCE plumes from drycleaner sites related to environmental insurance claims.

Radionuclides

Safety Light Superfund Site, PA - Evaluated available historical data, performed fate and transport analyses, and developed a detailed understanding of facility operations that provided the technical basis for recommendations to DOJ on a feasible strategy for and potential allocation of arranger liability. Site contaminated with numerous radionuclides (tritium [H-3], strontium [Sr-90], cesium [Cs-137], and radium [Ra-226]).

Tulsa, OK - Evaluated whether the response actions taken were reasonable and necessary related to the investigation and remediation of a cesium-137 release.

Berkeley, CA – Sampled tree rings in the vicinity of a Lawrence Berkeley National Laboratory stack that emitted tritium (H-3) and analyzed tree rings in order to reconstruct facility emission for >50 years.

Heavy Metals

Vernon, CA – Evaluated available historical emissions/capacity data, performed fate and transport analyses, and assessed the extent and magnitude of lead and other heavy metals contamination in soils surrounding the Exide Technologies lead battery recycling facility. Worked together with lead regulatory agency to develop interior/exterior assessment and remediation protocols. Analyzed reported results of community blood lead data.

Metal Recycling Facility, CA – Assessed facility compliance with DTSC hazardous waste regulations. Negotiated with DTSC on behalf of client. Developed plan for hazardous waste treatment/disposal that meets DTSC requirements.

Trona, CA - Expert Witness. Prepared an Expert Report regarding the contribution of an accidental elemental mercury spill at the Searles Valley Minerals Operations Inc. site to the overall historic site contamination. Analyzed invoices and categorized cleanup costs into emergency spill costs vs. soil remediation activities.

Pesticides

Atrazine, Numerous locations in USA – Provided expert litigation support regarding the fate and transport of atrazine, timing of release, and potential impacts to drinking water sources.

Glyphosate, Oakland, CA - Provided deposition and trial testimony regarding the source of glyphosate contamination causing property damage on an adjacent parcel of land based on atmospheric transport, technology dispersal capability, site conditions, and impact patterns on parcel.

Trichloropropane (1,2,3-TCP), California – Evaluated potential sources of trichloropropane groundwater contamination in drinking water wells.

Human Exposure Assessment

School District Astroturf – Collected astroturf samples and conducted consumer product testing to provide data which supported the assessment of potential exposure pathways and human health risk assessment for children, workers, and recreational users.

Proposition 65 Phthalates – Collected consumer product samples and conducted consumer product testing to determine potential consumer exposure pathways and magnitude.

Proposition 65 Heavy Metals – Evaluated lead data and developed a testing and evaluation plan to determine levels of naturally occurring metals in food products.

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Additional Areas of Expertise and Experience

Weapons of Mass Destruction Preparation and Response:

Provide technical guidance and operational plan reviews for responding to WMD events. Technical guidance includes emergency response, site characterization, WMD forensics, site remediation, fate and transport, site closure. Co-led team in development of DHS/EPA Federal facility restoration guidance document for critical infrastructure.

Development of Chemical/Isotopic Signatures/Fingerprints:

Develop and validate new chemical/isotopic fingerprint strategies as well as utilize peer-reviewed techniques. Experienced with numerous approaches: intended chemical markers and additives, chemical component ratios, degradation analysis, isotope analysis, biomarkers, isomers/congener analysis.

Chemical Fate and Transport Modeling:

Conducts analyses using a variety of industry-accepted approaches, including analytic solutions and numerical models MODFLOW, MT3D, HYDRUS, BIOCHLOR, CAMEO/ALOHA, CALPUFF, HPAC. Determines aqueous and/or atmospheric plume migration exposure duration and magnitude.

Used Oil System Collection and Recycling:

Expert knowledge of used oil characteristics, collection, transport, and recycling. Developed a report for the State of California on how to improve the state's used oil recycling program. Provided testimony to CA State legislature on proposed used oil recycling incentive bills. Key technical contributor to stakeholder discussion on ongoing CalRecycle efforts for additional used oil recycling improvement.

Journal Publications

Environmental Forensics:

Shelley, T.M.; Love, A.H. (2015) A Question of Proof: Using Isotope Analysis and Chemical Fingerprinting to Identify the Source of Contamination. *Environmental Claims Journal*, 27:3, 264-275

Zdon, A.; Davisson, M.L.; Love, A.H. (2015) Testing the Established Hydrogeologic Model of Source Water to the Amargosa River Basin, Inyo and San Bernardino Counties, California. *Environmental Forensics*. 16(4).

Love, A.H., J.R. Hunt, J.P. Knezovich. (2004) Improving Tritium Exposure Reconstructions Using Accelerator Mass Spectrometry. *Analytical and Bioanalytical Chemistry*. 379(2): 198-203.

Love, A.H., B.K. Esser, J.R. Hunt. (2003) Reconstructing Contaminant Deposition in a San Francisco Bay Marina. *Journal of Environmental Engineering*. 129 (7):659.

Love, A.H., J.R. Hunt, J.P. Knezovich. (2003) Use of Carbon-14 and Tritium in Tree Rings to Reconstruct Tritium Exposure at Lawrence Berkeley National Laboratory. *Environmental Science and Technology*. 37 (19): 4330.

Contaminant Fate and Transport:

Kuo, I-Feng; Grant, C.; Gee, R.; Chinn, S.; Love, A.H. (2012) Determination of the Surface Effects on Sarin Degradation *The Journal of Physical Chemistry C*. 116 (17), 9631-9635.

Love, A.H. (2008) Determining Important Parameters Related to Cyanobacterial Alkaloid Toxin Exposure. *Advances in Experimental Medicine and Biology*. Hudnell, H. Kenneth (Ed.). 619:453-464.

Loui, A., Ratto, T.V., Wilson, T.S., McCall, S.K., Mukerjee, E.V., Love, A.H., Hart, B.R. (2008) Chemical vapor discrimination

using a compact and low-power array of piezoresistive microcantilevers. *The Analyst*. 133(5): 608 – 615.

Love, A.H., M.L. Hanna, P.R. Coronado, J.G. Reynolds (2005) Engineering surface functions groups on silica aerogel for enhanced cleanup of organics from produced water. *Separation Science*. 40:311-320.

Love, A.H., Vance, A.L., Reynolds, J.G., Davisson, M.L. (2004) Investigating the affinities and persistence of VX nerve agent in environmental matrices. *Chemosphere*. 57: 1257-1264.

Weapons of Mass Destruction Preparation and Response:

Campbell, C.G.; Kirvel, R.D.; Love, A.H.; Raber, E. (2012) Decontamination After a Release of B. anthracis Spores. *Biosecurity and bioterrorism: biodefense strategy, practice, and science* 10(1):108-22.

Love, A.H.; Bailey, C.G.; Hanna, M.L.; Hok, S.; Vu, A.K.; Reutter, D.J.; Raber, E. (2011) Efficacy of Liquid and Foam Decontamination Techniques for Chemical Warfare Agents on Indoor Surfaces. *J. Hazardous Materials*. 196; 115-122.

Watson, A.; Hall, L.; Raber, E.; Hauschild, V.D.; Dolislagerd, F.; Love, A.H.; Hanna, M.L. (2011) Developing Health-Based Pre-Planning Clearance Goals for Airport Remediation Following Chemical Terrorist Attack: Introduction and Key Assessment Considerations. *Human and Ecological Risk Assessment: An International Journal*, 17(1) : 2 – 56.

Watson, A.; Dolislagerd, F.; Raber, E.; Hall, L.; Hauschild, V.D.; Love, A.H. (2011) Developing Health-Based Pre-Planning Clearance Goals for Airport Remediation Following a Chemical Terrorist Attack: Decision Criteria for Multipathway Exposure Routes. *Human and Ecological Risk Assessment: An International Journal*, 17(1) : 57 – 121.

Campbell C.J., Love A.H. (2008) Monitoring Water Resources for Threats to Water Security. *New Topics in Water Resources Research and Management*. Henrik M. Andreassen (Ed.). Nova Science Publishers, Inc. pp. 195-235.

Ramkumar, S.; Love, A.H.; Sata, U.R.; Kendall, R.J. (2008) Next-Generation Nonparticulate Dry Nonwoven Pad for Chemical Warfare Agent Decontamination. *Ind. Eng. Chem. Res.* 47: 9889-9895.

Other Publications

M.R. Johnson, J.G. Reynolds, Love, A.H. (2008) Improving Used Oil Recycling in California. *Contractor Report to the California Integrated Waste Management Board*. California Environmental Protection Agency. May 2008. Publication #610-08-008.

Vogel, J.; Love, A.H. (2005) Quantitating Isotopic Molecular Labels with Accelerator Mass Spectrometry. *Methods in Enzymology* 402:402-22.

Chiarappa-Zucca, M.L.; Dingley, K.H.; Roberts, M.L.; Love, A.H. (2002) Sample Preparation for Quantitation of Tritium by Accelerator Mass Spectrometry. *Analytical Chemistry* 74(24):6285-90.

Roberts, M.L.; Hamm, R.W.; Dingley, K.H.; Love, A.H. (2000) A compact tritium AMS system. *Nuclear Instruments and Methods in Physics Research Section B Beam Interactions with Materials and Atoms* 172(1-4):262-267.

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Selected Industry Conference Presentations

Environmental Forensics:

- Love, A.H.; Dorrance, L. (2016) Lessons in Applying Forensic Techniques to Sediment Sites Throughout the US. AEHS 26th Annual International Conference on Soil, Water, Energy, and Air, March 2016.
- Love, A.H.; Zdon, A. (2015) Assessing Limited Water Resources Water Resource Forensics. AEHS 25th Annual International Conference on Soil, Water, Energy, and Air, March 2015.
- Love, A.H., Brown, C. (2014) Robust Data Analysis for Utilizing Chemical Data for Forensic Applications. AEHS 24th Annual International Conference on Soil, Water, Energy, and Air, March 2014.
- Love, A.H. (2014) Incorporating Environmental Lines of Evidence into Nuclear & Criminal Forensics. Conference on Application of Accelerators in Research and Industry (CAARI). May 2014
- Shelley, T.M., Love, A.H. (2014) Prove it! – Using Isotope Analysis to Prove Contamination Source. FETTI Conference. October 2014.
- Love, A.H. (2013) Using 1,4 Dioxane as a Forensic Tool at Solvent Sites. Association for Environmental Health and Sciences Annual West Coast Conference. March 2013.
- Love, A.H. (2013) Testing the Established Regional Hydrologic Conceptual Model in the Amargosa River Basin, California and Nevada. National and International Conference on Groundwater. April 2013.

Contaminant Fate and Transport:

- Love, A.H., (2010) Understanding Agent Fate Systems: Is the perfect the enemy of the good? The 2010 Chemical and Biological Defense Science and Technology Conference. Orlando, Florida. 15-19 November 2010.
- Love, A.H., Koester, C.J., Alcaraz, A., Hanna, M.L., Ho, P., Reynolds, J.G., Raber, E. (2007) “Determining CWA Environmental Fate to Optimize Remediation for Indoor Facilities.” 2007 EPA Decontamination Workshop. Durham, North Carolina, June 20-22, 2007.
- Love, A.H., Koester, C.J., Alcaraz, A., Hanna, M.L., Ho, P., Reynolds, J.G., Raber, E. (2007) “Determining CWA Environmental Fate to Optimize Remediation for Indoor Facilities.” 6th DHS Conference on Chemical and Biological Technologies: Food Protection, Restoration, and Architecture Studies. Madison Wisconsin, June 5-8, 2007.
- Love, A.H. (2006) “Radiologic Dispersal Devices: Enhancing Response Capability” LLNL Educational Outreach to DTRA CB Defense. August 31, 2006. Fort Belvoir, Virginia.
- Love, A.H. (2005) Determining Important Parameters Related to Cyanobacterial Alkaloid Toxin Exposure. International Symposium on Cyanobacterial Harmful Algal Blooms (ISOC-HAB). U.S. Environmental Protection Agency. Durham, North Carolina. Sept 6-8, 2005.
- Love, A.H., Davisson, M.L., Vance, A.L., Reynolds, J.G. (2005) Understanding the Interaction of Chemical Agents with Environmental Matrices at Low Levels. Working Together: R&D Partnerships in Homeland Security. April 2005. Boston, Massachusetts.

Weapons of Mass Destruction Preparation and Response:

- Love, A.H., Hanna, M.L., Hok, S., Smith, W.J., Vu, A.K., Reutter, D., Raber, E. (2010) Evaluating Strategies for CWA Decontamination of Indoor Facilities. 2010 US EPA Decontamination Research and Development Conference. Research Triangle Park, North Carolina. April 13-15, 2010.
- Glascoe, L., Alai, M., Love, A.H., Johnson, M., Einfeld, W. (2005) A Technology Acquisition Strategy for the Security of Water

Distribution Networks. AWWA Water Security Congress. Oklahoma City, OK. April 2005.

Site Investigation and Remediation:

- Nuti, P., Love, A.H. (2010) Navigating the Complexities of Sediment Site Cleanup. 2010 EECMA Conference. May 2010.
- Love, A.H.; Stevens, M.A.; Silver, L. (2012) The Anatomy of an Environmental Standard. 2012 EECMA Conference. May 2012.
- Wozniak, A.A., Love, A.H. (2011) Optimizing Environmental Costs: Are Insureds Paying Too Much?. 2011 EECMA Conference. May 2011.

Professional Affiliations and Activities

- Editorial Board - Journal of Environmental Forensics
- Bar Association of San Francisco
- UC Berkeley Environmental Engineering Leadership Council
- International Society of Environmental Forensics
- American Chemical Society (ACS), Member # 2301067
- Forensic Expert Witness Association
- DRI
- Organization for the Prohibition of Chemical Weapons (2013 Nobel Peace Prize Recipient), US Analysis Team at Lawrence Livermore National Laboratory, 2004-2009.

Patents

- Systems and methods for generation of hydrogen peroxide vapor
United States Patent 08899556
- Stabilizing Griess reagent for explosives detection
United States Application 20070065944