# BRAD A. BESSINGER

Associate, Senior Geochemist

## AREAS OF EXPERTISE

- Geochemistry
- Contaminant Fate and Transport
- Water Resource Evaluations
- Environmental Forensics
- Reactive Transport Modeling
- Monitored Natural Attenuation

## SUMMARY OF QUALIFICATIONS

Dr. Bessinger specializes in environmental chemistry and the analysis of fate and transport of organic compounds and metals in the environment. His experience includes designing and conducting contaminant fate and transport studies, environmental forensics investigations, and water quality assessments. His consulting services include obtaining and interpreting geochemical and isotopic data, developing reactive transport models for sediment and groundwater, preparing site treatability studies, and investigating the sources of contaminants for litigation, insurance claims, and Natural Resource Damage Assessments (NRDA). His expertise in geochemistry and reactive transport modeling is routinely used in monitored natural attenuation (MNA) investigations and aquifer storage and recovery (ASR) evaluations.

**YEARS OF EXPERIENCE: 15+**

### EDUCATION

**PhD,** Geochemistry, University of California at Berkeley, 2000
**MS,** Rock Mechanics, University of California at Berkeley, 1997
**BS,** Engineering Geology, Stanford University, 1993

### REGISTRATIONS

**Registered Geologist:**
Oregon No. G2117
**Licensed Geologist:**
Washington No. 2847

### PROFESSIONAL HISTORY

**S.S. Papadopulos & Associates, Inc.,** Vice President, 2008 to present
**Exponent, Inc.,** Senior Geochemist, 2003–2008
**URS Corporation,** Senior Geochemist, 2000–2003
**University of California at Berkeley**, Research Assistant, 1994–2000

## REPRESENTATIVE EXPERIENCE

**S.S. Papadopulos & Associates, Inc.,** Portland, Oregon

### CONTAMINANT FATE AND TRANSPORT

- **Radionuclide Fate and Transport Modeling,** Missouri — Predicted the mobility of radionuclides in uranium processing wastes in a solid waste landfill. Conducted a laboratory evaluation of source mineralogy, speciation, and leaching potential. Developed a humic acid complexation thermodynamic database and used it to calibrate a reactive transport model. Evaluated the effectiveness of monitored natural attenuation (MNA) in preventing groundwater radionuclide migration to a nearby river. Identified significant factors affecting radium generation in leachate. Concluded significant attenuation would occur in the landfill vadose zone and underlying aquifer. Prepared a summary report for submission to the U.S. Environmental Protection Agency (USEPA).
- **Reactive Transport Modeling of Arsenic, Selenium, and Metals,** Nevada — Served as principal geochemist on a natural attenuation investigation of arsenic and metals in groundwater underlying a series of flue-gas desulfurization evaporation ponds. Evaluated historical data, directed field and laboratory investigations to characterize site geochemistry, and developed a reactive transport model to evaluate the effectiveness of natural attenuation. Prepared reports, presentations, and represented client to lead regulatory agency.
- **Hexavalent Chromium Leaching Investigation,** Washington — Evaluated the potential for hexavalent chromium to be leached into groundwater at the Hanford Site 100-D groundwater operable unit (OU). Developed kinetic-based, solid-solution reactive transport model that simulated soil column leaching tests. Geochemical formulation was incorporated into MT3D to evaluate field-based remedies.

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- **Port of Tacoma Arsenic Fate and Transport Study,** Washington — Conducted a geochemical investigation to determine arsenic mobility in groundwater affected by slag. Designed a geochemical study to assess arsenic speciation and mobility, including sequential extractions and batch leaching and adsorption tests. Ongoing project includes development of a reactive transport model to assess effectiveness of monitored natural attenuation (MNA).
- **Arsenic and Boron Source Mobility Study,** Florida — Conducted a geochemical investigation to determine arsenic and boron mobility at a former industrial facility. Metals speciation and mobility were determined using electron microprobe analysis, sequential extractions, and batch leaching and adsorption tests. Developed a reactive transport model to predict long-term impacts on drinking water aquifers.
- **Copper and Zinc Remedial Alternatives Evaluation,** British Columbia — Served as the lead geochemist on an interdisciplinary expert panel to assess the effectiveness of proposed remediation at an industrial site used for the loading and unloading of bulk mineral ore concentrates (copper, lead, zinc and nickel sulfides). Evaluated site data and previously unidentified remedial alternatives. Developed a conceptual site model of copper and zinc fate and transport to support the alternatives evaluation. Submitted a report to Environment Canada.
- **Monitored Natural Attenuation of Zinc,** Oregon — Developed a reactive transport groundwater model to evaluate the fate and transport of zinc in groundwater at a former zinc galvanizing site. Calibrated the model to existing site data, and forecasted the downgradient extent of zinc migration. Identified significant attenuation of zinc in the aquifer that would prevent impacts to a nearby river. Prepared report for client for submission to lead regulatory agency.
- **Fate and Transport of Polychlorinated Biphenyls (PCBs),** Missouri — Evaluated the potential for offsite, colloidal transport of PCBs via the groundwater pathway. Developed low-flow sampling and testing procedures and evaluated the effects of sample filtration by interpreting congener distributions in unfiltered groundwater, filtered samples, and filters. Also provided technical review of a PCB surface-water fate and transport/bioaccumulation model to determine the effectiveness of site remediation.
- **RCRA Facility Investigation of Lead Smelter, East** Helena, Montana — As senior geochemist for this project, identified geochemical and isotopic source signatures in groundwater to establish nature and extent of contamination. Consulting also included site geochemical investigations for development of a groundwater model and selection of remedial alternatives for arsenic and selenium contamination.
- **Arsenic Monitored Natural Attenuation (MNA) Performance Assessment,** Texas — Evaluated monitored natural attenuation (MNA) as a remedy for arsenic in groundwater. Designed a field, laboratory and modeling study following USEPA guidance on the use of MNA to achieve appropriate cleanup levels in groundwater within a reasonable timeframe. Identified attenuation mechanisms and rates, sequestration stability, and aquifer capacity. Developed a reactive transport model to demonstrate that monitored natural attenuation is an effective remedy for achieving appropriate cleanup levels in groundwater.
- **Hexavalent Chromium Fate and Transport Evaluation,** California — Designed a geochemical study of hexavalent chromium in groundwater. Conducted geochemical characterization of vadose zone soils to quantify adsorptive and reductive capacity. Incorporated laboratory results into a geochemical reactive transport model to assess fate and transport of historical releases. Prepared an expert report for litigation.
- **VOC Remediation Oversight,** Illinois — Provided third-party review for USEPA Region 5 at an industrial site contaminated by trichloroethylene (TCE) and carbon tetrachloride (CT) in groundwater. Reviewed and provided comments on technical reports describing remediation

performance monitoring results and in-situ treatability studies involving zero-valent iron (ZVI) and organic substrate amendments. Assessment included evaluating geochemical evidence for reductive dechlorination of solvents and potential field-scale implementation issues.

- **VOC Remedial Alternatives Evaluation,** Illinois — Reviewed the technical basis for selecting appropriate remediation of a TCE groundwater plume. For the USEPA, assessed the accuracy of conceptual and groundwater flow models being used to forecast contaminant fate and transport under several remediation scenarios. Evaluated spatial distribution of TCE in groundwater and conducted particle-tracking and statistical-trend analyses. Concluded that model calibration was poor and estimates of clean-up times highly uncertain. Provided recommendations on improving model predictions.
- **VOC Degradation Modeling,** New York — Conducted a technical review of PCE, TCE, and DCE degradation rates in sand and gravel aquifers. Identified probable degradation pathways based on site hydrogeology and geochemistry. Provided scientifically defensible degradation rate constants and retardation factors for modeling fate and transport of VOCs in groundwater.
- **Facilitated Dioxin Groundwater Transport Assessment,** Rhode Island — Evaluated the potential for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) to be mobilized by VOC cosolvents and/or natural dissolved organic matter in groundwater. Reviewed the scientific literature and developed a cosolvent solute-specific log-linear model to describe portioning between mobile and immobile phases. Established that site conditions are not conducive to facilitated groundwater transport; however, dissolved humic and fulvic acids could mobilize TCDD and generate concentrations in groundwater within the range of observations.
- **National Institute of Health Research Grant on Remediation of Recalcitrant Hazardous Substances in Sediment** — Conducted basic research into the use of reactive amendments as an alternative remediation technology for hazardous metal and metalloid contaminants (As, Hg, Se, Pb, Cu) of high priority in sediments at Superfund and other contaminated sites. Developed a biogeochemical reactive transport model to evaluate the effectiveness of various chemical amendments in reducing arsenic and mercury mobility in sediment caps. Model results were also investigated in laboratory experiments to identify reaction products and measure dissolution rates. The refined model and laboratory experiments were designed to assist in the selection of suitable sites for sediment capping.
- **Onondaga Lake Sediment Remedial Design,** New York — Predicted the long-term effectiveness of chemical amendments for neutralizing hyperalkaline pH and mercury in a proposed sediment cap. Conducted batch tests to assess the effectiveness of different chemical amendments in treating hyperalkaline pore water. Also developed geochemical models to simulate observed chemical changes and to predict long-term effectiveness under field conditions. Results were used as part of site feasibility studies, guiding the eventual remedy.
- **Groundwater Denitrification and Perchlorate Reduction Modeling,** California — Parameterized a Monod kinetic MT3DMS model for simulating denitrification and perchlorate reduction in a sand and gravel aquifer. Evaluated aquifer geochemistry and assigned rates for fate-and-transport calculations based on observed contaminant concentrations, inferred microbial activity, and inhibiting processes.
- **Acid Mine Drainage Remediation Performance Assessment,** California — Apportioned sources of arsenic and metals in a mine waste-contaminated stream using diagnostic ratios, mass balance, and chemical mixing/reaction models. Assessed changes in bioavailability due to site remediation by predicting the aqueous speciation of contaminants. Study results were used to determine remediation effectiveness for litigation.

- **Manganese Groundwater Plume Evaluation,** Oregon — Conducted a geochemical investigation to determine impacts of a dissolved manganese plume on ecological receptors in riverine sediment downgradient of an industrial site. Evaluated groundwater, sediment, and pore water biogeochemistry and concluded manganese attenuation was occurring. Manganese concentrations in sediment pore water were demonstrated to be within the natural range, resulting in the suspension of site regulatory activities.
- **Hanford Groundwater Geochemistry and Chromium Modeling,** Washington — Project work included technical review of documents providing the basis for modeling chromium using MT3DMS. Also developed environmental calculation briefs for evaluating and interpreting groundwater geochemistry.
- **Adaptation of Hydrocarbon Model for Multicomponent Simulations,** USEPA — Determined biodegradation rate parameters for modeling surrogate petroleum hydrocarbon compounds using the USEPA's Hydrocarbon Spill Screening Model (HSSM). Evaluated the scientific literature and developed reaction stoichiometries and appropriate rate constants. Also provided technical guidance on code modification.
- **VOC Exposure Assessment,** Illinois — Assessed the potential for historical atmospheric emissions of vinyl chloride and 1,1-dichloroethene (1,1-DCE) from an industrial facility. Developed a kinetic model describing volatilization and polymerization within the plant's reactors. Also modeled potential releases from an industrial lagoon receiving plant effluent. Results were used in developing expert opinions on alleged exposure as part of a toxic tort case.
- **VOC Remediation Performance Assessment,** Oregon — Evaluated the effectiveness of groundwater remediation efforts on reducing concentrations of volatile organic compounds (VOCs) in groundwater. Work was conducted as part of a site remediation performance assessment.
- **Slag Impact Evaluation,** Oregon — Evaluated groundwater quality data to determine the potential impact of slag materials on metals concentrations in downgradient monitoring wells. Used geochemical modeling to demonstrate offsite migration of dissolved metals was being mitigated by natural attenuation.

### ENVIRONMENTAL FORENSICS

- **Groundwater Metals Source Investigation,** Nevada — Served as principal geochemist to identify the nature and extent of Total Dissolved Solids (TDS) and metals in naturally-saline groundwater. Work included the development of field and laboratory monitoring programs. Also identified source signatures using statistical methods, elemental ratios, and stable isotopes. Assessed potential impacts from natural brines, desulfurization pond releases, agricultural infiltration, and petroleum hydrocarbon releases.
- **PCE and TCE Groundwater Degradation Evaluation,** California — Assessed the potential for migration of PCE and TCE in a groundwater aquifer having multiple sources. Examined evidence for attenuation along a flowpath due to reductive dechlorination, abiotic degradation, and/or adsorption. Evaluated groundwater geochemistry to identify conditions conducive to attenuation and used compound ratio analysis and reactive transport modeling to test hypotheses. Work was performed as part of litigation to apportion relative contributions to a chlorinated solvent groundwater plume.
- **Groundwater Contaminant Source Evaluation,** Wyoming — Served as technical expert in litigation over sources of arsenic and organic contaminants in groundwater in the vicinity of a solid waste landfill. Performed statistical evaluations to determine background concentrations. Also determined sources of major ions in groundwater using geochemical mixing calculations. Prepared quarterly monitoring reports in compliance with State regulations. Prepared an expert report and

provided a deposition.

- **Groundwater Arsenic Source Study,** Montana — Conducted an evaluation of potential sources of arsenic in groundwater in a smelter community. Compared reported dissolved concentrations to background levels, performed reactive transport modeling to assess migration from surface contamination, and utilized ion and isotopic ratios to distinguish water sources. Results were summarized in an expert report prepared for a toxic tort case.
- **Chlorinated Solvent Plume Evaluation,** California — Critically evaluated methods used by plaintiffs' technical expert for determining sources of VOCs (PCE, TCE, TCA, and 1,1-DCE) in groundwater. Identified and quantified uncertainty in source assessment using diagnostic ratios to age-date solvent plumes and determine source proximity. Also reviewed and summarized scientific literature on abiotic and biotic degradation and effects on data interpretation.
- **Post-Construction Mercury Source Study,** Washington — Identified sources of mercury in groundwater in a series of monitoring wells having concentrations above site action levels. Conducted statistical analysis and developed a geochemical model that simulated interaction between soil organics and mercury. Concluded (presented in the site remediation performance assessment) that measured concentrations were related to the natural biogeochemical cycling of peat.
- **San Diego Harbor Sediment Environmental Forensics Investigation,** California — Investigated sources of polychlorinated biphenyls (PCBs) in harbor sediment. Evaluated historical sources, Aroclor and homolog concentrations, and the distribution of PCB congener fingerprints. Prepared a report for mediation between potentially responsible parties.
- **Port of Los Angeles Contaminated Sediment Investigation,** California — Investigated the sources of metals in contaminated sediment. Performed statistical and spatial analyses of sediment chemistry, and prepared a report allocating client contribution to observed contaminant levels.
- **City Well Contamination Study,** Idaho — Evaluated potential sources of petroleum hydrocarbons, BTEX compounds, and PAHs to groundwater in this city's municipal wells and sediment. Study included review of historical site operations, comparison of data to site background, and spatial distributions. Results were used to assist client in resolving potential environmental site liabilities.
- **VOC Source Assessment,** California — Conducted an apportionment evaluation to determine the relative contribution of VOCs (PCE, TCE, TCA, 1,1-DCE, 1,2-DCE, and 1,1-DCA) in groundwater and indoor air. Utilized chemical ratios to determine sources and degradation rates of compounds. Reactive transport modeling was used to support apportionment.

### WATER QUALITY ASSESSMENTS

- **Cornelius Aquifer Storage and Recovery (ASR) Compatibility Evaluation,** Oregon — Conducted an evaluation of chemistry data from the City of Cornelius's ASR system. Work included an evaluation of potential changes in water quality caused by mixing groundwater with injected water. This project also included an assessment of mineral precipitation reactions that could potentially occur in the ASR system. Calculations were performed using the U.S Geological Survey (USGS)-supported geochemical model PHREEQC. Provided a summary report concluding that no detrimental water-quality changes or subsurface mineral precipitation were likely to occur.
- **WRD Aquifer Storage and Recovery Arsenic (ASR) Evaluation,** California — Performed a geochemical assessment for the Water Replenishment District (WRD) of Southern California to evaluate potential effects of the ASR system on liberation of arsenic from aquifer minerals. Designed a laboratory study of aquifer sediments, including arsenic speciation and sequential extraction analysis. Ongoing project includes technical oversight and geochemical modeling using

the USGS-supported geochemical model PHREEQC.

- **Kennewick Aquifer Storage and Recovery (ASR) Efficiency Evaluation,** Washington — Evaluated chemistry of recovered water to quantify the relative proportion of injected water recovered during system operation. Reviewed general chemistry of injected water and groundwater and developed mixing curves for indicator constituents to assess relative proportions present in recovered water. Also identified water-aquifer reactions deduced from the mixing curves and the potential long-term effects of these reactions on water quality. Developed a 2D reactive transport model to confirm hypotheses.
- **Woodland Aquifer Storage and Recovery (ASR) Mineralogy Evaluation,** California — Conducted an evaluation of the effects of aquifer geochemistry on the quality of recovered water from the proposed City of Woodland's ASR system. Reviewed mineralogical and chemistry data and used the USGS-supported geochemical model PHREEQC to assess potential impacts associated with arsenic, selenium, and hexavalent chromium in aquifer minerals. Also determined effects associated with residual ozone. Provided model predictions and recommendations on system operation to reduce potential impacts.
- **WRD Aquifer Storage and Recovery (ASR) Compatibility Evaluation,** California — Evaluated water chemistry data in support of the Water Replenishment District of Southern California's Indirect Potable Reuse (IPR) Injection Well Feasibility Study. Work included using PHREEQC to assess the likelihood of mineral precipitation reactions to cause clogging, and the identification of processes that could generate elevated concentrations of arsenic in recovered water. Concluded no impacts were likely. Provided recommendations to mitigate any observed effects in the future.
- **Calleguas Aquifer Storage and Recovery (ASR) Well Performance Assessment,** California — Evaluated sources of poor ASR system well performance in selected wells for the Calleguas Water District. Reviewed water-chemistry data and identified potential clogging issues associated with degassing and strong redox-fronts in the vicinity of affected wells. Provided recommendations on changes in injection well chemistry and pumping rates to improve performance.
- **Tigard Aquifer Storage and Recovery (ASR) Compatibility Evaluation,** Oregon — Evaluated potential changes in water quality caused by mixing groundwater with injected water for the City of Tigard ASR system. Reviewed laboratory data and performed mixing calculations using the USGS-supported geochemical model PHREEQC. Determined potential for mixing to affect dissolved constituent concentrations (including trihalomethanes) and the potential for mineral precipitation/clogging of the system. Prepared summary report for client.
- **Meridian Aquifer Storage and Recovery (ASR) Aquifer Conditioning Study,** Idaho — Determined the feasibility of conditioning an aquifer to create an oxidized treatment zone to remove dissolved manganese from public supply groundwater for the City of Meridian. Designed sampling and analysis plans to characterize the geochemical conditions in the aquifer. Also developed a reactive transport model to simulate pilot-scale conditioning experiments, thereby identifying the factors that control oxygen demand and manganese concentrations. The model was used to identify the number of cycles needed to achieve conditioning and to evaluate the performance of chemical oxidants to achieve more rapid aquifer oxidation.
- **Marcellus Shale Baseline Water Quality Evaluation,** West Virginia — Conducted a baseline water-quality assessment in an area undergoing natural gas exploration and production. Compared constituent concentrations in groundwater to standards protective of drinking water resources. Also determined potential sources of dissolved ions using ion ratio plots and compared these results to previous investigations in the region. Evaluated composition of hydrocarbon gases in shallow groundwater to establish baseline sources and ambient concentrations. A monitoring report was developed that identified water-quality impairments pre-dating Marcellus gas production.

- **USEPA Pavillion Hydraulic Fracturing Study Technical Review,** Wyoming — Reviewed the technical basis for the USEPA's conclusion that hydraulic fracturing fluids were contaminating groundwater in a shallow aquifer in Pavillion, Wyoming. Evaluated site hydrology, well construction, laboratory reports, and reported concentrations of inorganic ions and petroleum hydrocarbons. Concluded that poor well construction was impacting groundwater chemistry. Also found that the USEPA based its conclusions on questionable laboratory data and did not adequately consider natural background conditions.
- **Mamm Creek Natural Gas Development Water-Quality Study,** Colorado — Evaluated groundwater quality in a natural gas-producing area to assess potential impacts associated with hydraulic fracturing and extraction. Analysis included an evaluation of spatial and temporal trends in chloride concentrations and an evaluation of methane sources as inferred from stable carbon isotopes. Provided baseline and impact reports.
- **Pipeline System Clogging and Remediation,** New Mexico — Conducted a geochemical study to identify the cause of pipeline scale and to determine whether or not there was an alternative to periodic cleaning and rehabilitation. Work involved laboratory characterization of scale and geochemical modeling to identify factors responsible for its formation. Results were used to guide decisions on pipeline operation and maintenance.
- **Columbia Basin Groundwater Ages Study,** Washington — Participated in a study assessing groundwater ages in the Columbia Basin Ground Water Management Area. Work utilized radiogenic isotopes and predictive numerical models to assess effects of agricultural withdrawals on the long-term supply of irrigation water.
- **Groundwater Acid Neutralization Study,** Oregon — Conducted a geochemical evaluation of a shallow aquifer that was contaminated by historical releases of acidic process water to identify *in-situ* remedies for neutralization. Identified mechanisms and rates of pH neutralization from bench-scale tests and evaluated potential field-scale performance for a focused feasibility study. Field application of the groundwater amendment successfully neutralized acidity.
- **Columbia Basin Gas Characterization,** Oregon — Performed a genetic characterization of gases in groundwater wells to assess potential natural gas resources. Distinguished methane sources by using dissolved and free gas compositions, stable carbon and hydrogen isotopes, and groundwater ages.
- **Groundwater Treatment System Optimal Operation Evaluation,** California — Identified optimal operating conditions for groundwater treatment systems based on water chemistry. Evaluation included systems to remove arsenic from groundwater by using ferric chloride and systems to prevent scale formation by using dissolved carbon dioxide.
- **Aquifer Storage and Recovery (ASR) Systems Modeling,** Washington — Investigated geochemical characteristics that affect the concentrations of arsenic and trihalomethanes (THMs) in these aquifer storage and recovery systems. Developed a kinetic-based reactive transport model to evaluate the effects of site-specific geochemistry and operating conditions on groundwater quality.
- **Stream Impact Assessment,** Michigan — Modeled the effects of reduced outflow from a surface impoundment on downstream water temperature.

## EXPONENT, INC., PORTLAND, OREGON

### CONTAMINANT FATE AND TRANSPORT

- **Raritan River RI/FS Investigation,** New Jersey — Developed a geochemical reactive transport model to predict the potential for recontamination of clean cover materials placed over arsenic-contaminated sediments in a tidal wetland affected by industrial discharges and dumping. Used

the model to evaluate the long-term effectiveness of a proposed cap.

- **Arsenic Remedial Alternatives Evaluation,** Minnesota — Designed and executed a geochemical study of arsenic fate and transport in groundwater at a former pesticide manufacturing facility. Developed field sampling plans, laboratory studies, and an integrated PHREEQC/MT3DMS model to predict the extent of arsenic migration to a potential water-supply aquifer. Evaluated the effectiveness of engineered remedial alternatives using model output for a site feasibility study.
- **Lake Tenkiller Natural Resource Damage Assessment (NRDA),** Oklahoma — Provided litigation support as part of a Natural Resource Damage Assessment (NRDA) lawsuit. Investigated the fate and transport of arsenic, nutrients, pathogens, and metals in poultry litter applied within an agricultural watershed. Examined geochemical evidence for transport from litter-applied fields to rivers, streams, and lacustrine sediment, and compared to background and other anthropogenic sources. Also assessed biodegradation pathways and rates of organo-arsenical compounds and potential of these additives to be preserved in poultry litter and therefore susceptible to aerial dispersion and deposition as house dust.
- **Contamination Assessment and Reduction Project (CARP) Model Review for the Passaic River,** New Jersey — Provided technical review of the CARP model for metals and organic contaminants in the Passaic River and Newark Bay. Evaluated adequacy of modeled geochemical processes and uncertainty associated with model-predicted source contributions and remediation effectiveness.
- **Mercury Fate and Transport Evaluation,** New Jersey — Summarized the current scientific understanding of mercury transport, fate, and bioaccumulation for a client affected by regulatory actions concerning mercury methylation. Results were used by client to ensure cost effectiveness and success of proposed remedial actions.
- **Red Dog Mine Barium Investigation,** Alaska — Calculated the bioavailability of barium in soil affected by fugitive dust from mining operations. Evaluated field and laboratory methods for determining barium concentrations in soils, and developed geochemical models to interpret *in vitro* test results. Results were used in ecological risk assessment and were published as a peer-reviewed journal article.
- **Chromated Copper Arsenate (CCA) Geochemical Evaluation,** Florida — Evaluated the fate and transport of arsenic in CCA-treated wood being disposed in construction and debris landfills. Examined lysimeter experiments, speciation results, and groundwater monitoring data. Provided comments on the scientific validity of published conclusions regarding these data.
- **Chromium Geochemical Modeling,** New Jersey — Evaluated the natural attenuation of hexavalent chromium in a tidal marsh. Identified the major geochemical factors restricting migration under variable environmental conditions. Incorporated field and laboratory data into a kinetic-based, reactive transport model. Predicted potential migration of hexavalent chromium to soil and groundwater.
- **Arsenic and Lead Bioavailability Investigations,** Missouri / New York — Identified the sources and relative bioavailability of arsenic and lead in soil in smelter communities. Compared mineralogy to ore concentrate material, smelter emissions, soil alteration products, and other anthropogenic sources. Developed reports to supplement human health-risk assessments.
- **Groundwater Transport of PCBs,** Washington — Evaluated the fate and transport of PCBs in groundwater at a site upgradient of an impaired surface-water body. Analyzed historical hydrology and chemistry data to identify source areas. Calculated solubility and identified transport mechanisms for specific congeners in groundwater. Used fate-and-transport modeling to demonstrate that groundwater contamination is unlikely to contribute to the observed impairment.

### ENVIRONMENTAL FORENSICS

- **Metals and Arsenic in Soil,** West Virginia — Managed an investigation of the contribution of a former smelter to concentrations of arsenic, cadmium, lead, and zinc in residential soil and house dust. Identified natural and anthropogenic sources of metals in the affected communities and statistically assessed background. Used spatial distribution and metal ratios to ascertain source. Prepared expert report to contest claims filed in a class-action lawsuit.
- **Manufactured Gas Plant Polycyclic Aromatic Hydrocarbons (PAHs) Source Assessment,** Washington — Managed an environmental forensics investigation of the sources of (PAHs in sediment near a former manufactured gas plant (MGP) and tar refinery. Analyzed historical documents pertaining to site operations and developed sampling and analysis plans to obtain source materials. Utilized chemical fingerprinting techniques to apportion sources as part of a cost allocation case.
- **Bulk Fuel Terminal Plant Polycyclic Aromatic Hydrocarbons (PAHs)** (**PAHs) Source Assessment,** Oregon — Managed an investigation of the sources of PAHs in sediment in an industrial waterway near a bulk fuel terminal. Developed site sampling and analysis plans to obtain source and sediment samples for chemical fingerprinting.
- **Phosphorus Source Assessment,** Washington — Managed a study to assess sources of elevated groundwater phosphorus concentrations suspected of contributing to lake eutrophication. Analyzed groundwater data and developed a geochemical reactive transport model to demonstrate the relative importance of natural versus anthropogenic sources. Report provided to lead agency in consideration of possible remedies.
- **Metals and Hydrocarbons in Waterway Sediment,** Washington — Assessed the contributions of industrial sources on polycyclic aromatic hydrocarbons (PAHs) and metals concentrations in an industrial waterway. Utilized site histories, industrial practices, and site discharge data to reconstruct historical releases and calculate mass loadings. Prepared report for a cost recovery lawsuit.
- **Oil Refinery Source Assessment,** New Jersey — Investigated sources of petroleum hydrocarbons and other organic and inorganic compounds at petroleum refineries and petrochemical facilities. Reconstructed site operations, materials handled, waste disposal practices, and process chemicals used. Related chemicals to those identified as exceeding soil quality criteria. Considered natural and urban background. Developed report for a Natural Resource Damage Assessment (NRDA) lawsuit.
- **Residential Soil Arsenic Contamination Evaluation,** Minnesota — Evaluated sources of arsenic in soils potentially affected by historical manufacturing of arsenical pesticides. Utilized electron microprobe speciation and metal ratio techniques to identify chemical fingerprints.
- **Mercury in Indoor Air Evaluation,** Pennsylvania — Evaluated claims of mercury exposure caused by removal of natural gas pressure regulators. Critiqued removal procedures and calculated evaporation rate of elemental mercury. Documented sources/evidence of variability in exposure caused by removal. Prepared expert report to contest claims filed in a class-action lawsuit.
- **Dioxin in Lake Sediment Expert Testimony Support,** Texas — Provided expert testimony support for a study evaluating the transport and fate of dioxin in lacustrine environments. Reviewed site-specific loads, hydrology, and chemical data. Compared likely sediment transport processes to potential air deposition pathways. Used scientific results, site history, and sworn depositions to apportion dioxin contributions to sediment

### WATER QUALITY ASSESSMENTS

- **Guadalupe River Mercury Total Maximum Daily Load (TMDL) Assessment,** California —

Reviewed technical basis for establishing numeric targets for a proposed TMDL for the Guadalupe River in California. Evaluated site data and provided guidance on effectiveness of various source control measures and methyl mercury reduction plans. Prioritized measures based on effectiveness and the potential for successful implementation.

- **San Francisco Bay Mercury Total Maximum Daily Load (TMDL) Assessment,** California — Analyzed effectiveness TMDL for mercury in San Francisco Bay. Evaluated assumptions inherent in the scientific approach within the context of source assessment and numeric targets, mercury methylation, and food web pathways. Demonstrated that proposed numerical targets for mercury inadequately consider mercury speciation. Assessment report was used in contention of source allocations.
- **Semi-Permeable Membrane Devices Technical Review,** Alaska — Provided senior review of the ability of Semi-Permeable Membrane Devices (to predict time-weighted average hydrocarbon concentrations in water and receptor tissues. Evaluated existing field and laboratory studies. Provided summary report on method effectiveness and limitations.
- **Groundwater Use Investigation,** California — Evaluated clogging issues associated with groundwater extraction and irrigation. Results of this project were used in insurance claim.
- **Groundwater Remediation Performance Assessment,** California — Assessed the performance of groundwater remediation activities at a petroleum-impacted site as part of a cost recovery lawsuit.

**URS Corporation,** Portland, Oregon **/** Oakland, California

- **San Francisco International Airport Runway Reconfiguration Study (SFO/FAA),** California — Managed geochemical modeling activities for a study of the effects of dredging and disposal in San Francisco Bay. Calibrated and verified numerical biogeochemical reactive transport models for copper, mercury, nickel, PAHs, and PCBs in San Francisco Bay. Presented and defended findings to panel of government and academic experts assembled by the National Oceanic and Atmospheric Administration (NOAA). Wrote technical reports in support of anticipated NEPA/CEQA requirements and published results.
- **San Luis Drain Alternatives Evaluation Project, Bureau of Reclamation,** Sacramento, California — Managed MIKE 21 modeling tasks for this project. Developed reactive transport models to predict changes in salinity at water treatment plant intakes and selenium bioaccumulation in ecological receptors. Work was performed for NEPA/CEQA certification.
- **Contaminated Upland Marsh Mercury Study, UC Berkeley, Richmond Field Station,** California — Managed mercury bench-scale treatability study for remediation of a contaminated upland marsh. Evaluated *in situ* treatment alternatives for remediating mercury-contaminated groundwater using site geochemistry, laboratory treatability tests, and reactive transport model predictions. Final remediation based on study results. Results published in peer-reviewed scientific literature.
- **Bulk Fuel Terminal Natural Attenuation Study,** Portland, Oregon — Supervised this natural attenuation study. Developed site sampling and analysis plans to assess the geochemistry and current nature and extent of contamination. Developed a reactive transport model that included hydrocarbon degradation, redox reactions, and arsenic transport. Used model predictions to support results and recommendations for the site RI/FS.
- **San Francisco Bay Metals Contamination,** Martinez, California — Modeled potential groundwater and surface-water contamination resulting from exposed cinder piles in a marsh. Assessed the effectiveness of engineered and natural barriers to protect surface water and groundwater from discharges of copper, zinc, and acid. Results of groundwater/surface-water reactive transport models were used by the client to justify appropriate cleanup levels and remedial design to the lead

regulatory agency.

- **Sediment Remediation Evaluation,** California — Performed water-quality modeling of inorganic and organic contaminants associated with dredging and disposal of contaminated sediments in San Francisco Bay. Developed custom chemical software, and compared predictions to water quality objectives as part of a sediment remediation effort.
- **Nitrate Impacts in Groundwater Evaluation,** Washington — Performed a groundwater quality evaluation as part of a waste discharge permit renewal application. Assessed potential impacts associated with the use of treated wastewater for irrigation.
- **Landfill Permit Groundwater Evaluation,** Oregon — Performed groundwater monitoring and statistical analysis of water-quality data for landfill permitting.
- **Quarry Operations Water-Quality Evaluation,** California — Evaluated water-quality data to determine potential impacts of quarry operations on surface water.

**University of California at Berkeley, California**

- **Metal/Metalloid Transport in Groundwater,** California/Nevada — Conducted scientific research on the geochemistry of arsenic, antimony, mercury, gold, and silver. Evaluated laboratory experiments, compiled thermodynamic databases, and developed software for statistically evaluating speciation and mobility at ambient and elevated temperatures and pressures. Results published in reports prepared for Lawrence Berkeley National Laboratory.
- **Yucca Mountain Nuclear Waste Repository,** Nevada — Served as a geologic consultant to the Mineral and Nuclear Engineering Department faculty at the University of California at Berkeley. Assessed potential migration of radionuclides in the proposed nuclear waste repository. Analysis published in a peer-reviewed scientific journal.

## PUBLICATIONS & PRESENTATIONS

Bessinger, B., V. Bedekar, M. Tonkin, J. Szecsody, N. Qafoku, and M. Truex, 2015. Simulation of Co-Precipitated Chromate-Calcite at a Waste Site. Presentation at MODFLOW and More 2015: Modeling a Complex World, Golden, CO, May 31-June 3, 2015.

Bessinger, B., and C. Neville, 2015. Solute Transport Modeling: Ideal and Otherwise. Presentation of Short Course at the 10th Washington Hydrogeology Symposium, Tacoma, WA, April 14-16, 2015.

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## DEPOSITION AND TESTIMONY EXPERIENCE

### *DEPOSITION*

2010 Sublette County v. Wyoming Department of Environmental Quality. Case No. 09-5601. January 20, 2010.