

## Gregory J. Smith, P.E.

### Education

- M.Sc. Hydrogeology, 1984, University of Alberta, Edmonton, AB, Canada
- B.A.Sc. Geological Engineering, 1980, University of Windsor, Windsor, ON, Canada

### Summary

Mr. Smith, P.E., President of Heath-Ventura, is a Geological Engineer and Hydrogeologist with more than 35 years of experience in the field of soil and groundwater investigation and remediation, stable isotope evaluations, and expert witness experience including expert and factual witness testimony, opinion paper preparation, and environmental forensics. This work has been performed at project locations around the industrialized world (e.g., across the U.S., Canada, Mexico, Australia, Brazil, Spain, France, Germany, England, and Japan).

Greg is well known for his pioneering breakthroughs in the remediation of chlorinated solvents from soils and groundwater and is recognized for having successfully completed possibly the nation's first dense non-aqueous phase liquid (DNAPL) cleanup in groundwater to regulatory limits in 1999. He is well-published and a recognized lecturer at international technical forums. Greg has co-authored an *Encyclopedic Dictionary of Hydrogeology*, published by Academic Press (March, 2009), and authored a chapter on thermal effects in *Electrochemical Remediation Technologies for Polluted Soils, Sediments and Groundwater*, published by John Wiley & Sons, as well as numerous technical papers in peer reviewed publications and conference proceedings. He is a patent holder for the *Ground Contamination Remediation Process* U.S. Patent No. 5,279,740; and electro-kinetic consolidation of fine tailings (CA2736675) and water recovery (CA2758872) processes. Mr. Smith also developed a low temperature in situ thermal treatment method (patent applied) that has yielded cost savings of approximately 25% compared to conventional thermal treatment methods on multiple sites.

Mr. Smith has been at the forefront for the use of Compound Specific Isotope Analysis (CSIA), beginning with the use of bulk isotope analysis in the late 1990s and

compound specific isotope analysis to aid in the interpretation of contaminant migration, concentration reduction mechanisms and source identification. This data was instrumental in foreshortening ongoing remediation efforts at a site in Australia, where the CSIA data demonstrated offsite source that were not the responsibility of the client. At a site in Japan, CSIA was used to demonstrate that intrinsic degradation of chlorinated solvents in groundwater was occurring and could be incorporated into the remedial design, significantly reducing the scope of the groundwater remediation. In Brazil, Mr. Smith used CSIA to differentiate the concentration reduction from chemical oxidation versus intrinsic biodegradation.

### Professional Affiliations & Registrations:

- Association of Professional Engineers, Geologist, and Geophysicists of Alberta
- Association of Groundwater Scientists and Engineers
- Professional Engineer, Alberta, Canada

### Patents and Pending Patents:

- Basile, A.J., G.J. Smith, and J.W. Aiken (1994). *Ground Contamination Remediation Process*. U.S. Patent No. 5,279,740. Also patented in Canada, Europe, Australia and Taiwan.
- Smith, G.J., B.S. Beattie, R. C. Parrot, J. Micak and P. Garcia (2011). *Electrokinetic Process and Apparatus for Consolidation of Oil Sands Tailings*. Canada Patent No. CA2736675.
- Smith, G.J., B.S. Beattie, R. C. Parrot, J. Micak and P. Garcia (2011). *Electrokinetic Process and Apparatus for Water Recovery from Oil Sands Tailings*. Canada Patent No. CA2758872.
- Smith, G.J., J. Baldock, and J. Dablow. *Low Temperature Thermal Treatment Process for Soil and Groundwater Remediation* (U.S. patent applied).

### Selected Publications:

Smith, G.J., C. Thomas, and Y. Wang (2016) *Compound Specific Isotope Analysis of Remediation Mechanisms During In Situ Thermal Treatment*. Proceedings of the Second International Conference on Remediation of Chlorinated and Recalcitrant

- Compounds, May 22-26, 2016, Palm Springs, CA, USA.
- Smith, G.J., J. Baldock, J. Brett, J. Dablow (2016) *Sustainable Low Temperature In-Situ Thermal Remediation Using Dissolved Gases. Proceedings of the Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds, May 22-26, 2016, Palm Springs, CA, USA.*
- Smith, G.J., and Y. Wang (2016) *Compound Specific Isotope Analysis (CSIA) Evaluation of Slow Release Permanganate Cylinders (SRPC). Proceedings of the Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds, May 22-26, 2016, Palm Springs, CA, USA.*
- Smith, G.J. and Y. Wang (2015) *Treatment Optimization through Refinement of a Conceptual Site Model Using Compound Specific Isotope Analysis. Proceedings of the Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds, May 22-26, 2016, Palm Springs, CA, USA.*
- Wang, Y. and G. Smith (2011). *Advanced Site Diagnostic Tool: 3D-CSIA for In Situ Remediation. Remediation, Vol 21, No.1, pp 79-96.*
- Smith, G.J. and Y. Wang (2011) *Changes to Stable Isotope Ratios and Groundwater Chemistry During Electrical Resistance Heating. Remediation, Vol. 21, No 1, pp 97-114.*
- Smith, G. and Y. Wang (2010) *Stable Isotope Diagnostics of Chlorinated Solvents in Contaminated Aquifers. Environmental Forensics, Proceedings of the 2009 INEF Annual Conference, R.D. Morrison and G.O Sullivan Eds.*
- Wang, Y., A. Jeffrey and G. Smith (2010). *Forensic Application of Environmental Isotopes in Chlorinated Solvent Investigations. Environmental Forensics, Proceedings of the 2009 INEF Annual Conference, R.D. Morrison and G.O Sullivan Eds.*
- Poehls, D.J. and G.J. Smith (2009) *Encyclopedic Dictionary of Hydrogeology*. Wm. P. Ganus, R.W. Hurst, and L. Smith (Contributing Eds.), © Academic Press, New York, NY (Published March 9, 2009; ISBN-13: 978-0125586900).
- Smith, G.J. (2008). *Electrochemical Remediation Technologies for Polluted Soils, Sediments and Groundwater*, Chapter 24 in Electrochemical Remediation Technologies for Polluted Soils, Sediments and Groundwater, K. Reddy and C. Cameselle, Eds. © John Wiley & Sons, 2009 (ISBN 978-0-470-38343-8)
- Smith, G.J. (2008). *Symbiotic Effects of Biodegradation During Electrical Resistance Heating. Proceedings of the Sixth International Conference of Remediation of Chlorinated and Recalcitrant Compounds, May 19-22, 2008, Monterey, California.*
- Smith, G.J. and G. Beyke (2007) *Advances in the Application of In Situ Electrical Resistance Heating, Proceedings of the 11th International Conference on Environmental Remediation and Radioactive Waste Management ICEM2007 September 2-6, 2007, Oud Sint-Jan Hospital Conference Center, Bruges, Belgium.*
- Smith, G.J. (2008) *Biogeochemical Changes Induced by In situ Electrical Resistance Heating. Proceedings of the Fifth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, May 7 - 10, 2007, Baltimore, MD,*
- Powell, T., G. Smith, J. Sturza, K. Lynch, and M. Truex (2007) *New Advancements in In Situ Treatment Using Electrical Resistance Heating. Remediation, Spring 2007, © Wiley Periodicals, Inc.*
- Smith, G.J., J. von Hatten, and C. Thomas (2006) *Monitoring Soil Consolidation during Electrical Resistivity Heating. Proceedings of the Fifth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, May 22-25, 2006, Monterey, CA,*
- Smith, G. J., J. von Hatten, G. Beyke, and J. Ackerman (2004) *Evaluation of Potential Soil Subsidence Resulting from In Situ Electrical Resistivity Heating. Proceedings of the Fourth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, May 24-27, 2004, Monterey, CA,*
- Dumdei, B., G. Smith, and R. O'Brien (2004). *Ambient Monitoring for TCE with Automated Real-Time Gas Chromatography*. Paper number 04-A-448 for publication in proceedings of annual AWMA meeting.
- Dowiak, M., G.J. Smith, K. Darcy, B. Dumdei and J. Imbrie (2002) *Monitoring of Zero Valent Iron Injection Pilot Test for Trichloroethene Treatment.*

Proceedings of the Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds, May 20-23, 2002, Monterey, CA.

Smith, G. J. (2001) *Reducing Reserves for Corporate Environmental Liability Through the use of Innovative Remediation Technologies*. Proceedings of the Association of Certified Hazardous Materials Managers National Meeting, Chicago, IL.

Smith, G., D. Fleming, V. Jurka, and T. Adams (2000) *Closure of a Trichloroethene and 1,1,1-Trichloroethane DNAPL Remediation Using Thermal Technologies*. Proceedings of the Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds, May 22- 25, 2000, Monterey, CA.

Beyke, G., G. Smith, and V. Jurka (2000) *DNAPL Remediation Closure with Six-Phase Heating*. Proceedings of the Second International Conference on Remediation of Chlorinated and Recalcitrant Compounds, May 22-25, 2000, Monterey, CA.

## Project Work Examples:

**Steam Injection Remediation Design for DNAPL Removal, Japan. Confidential Automotive Supplier.** Mr. Smith was part of the design team for a soil and groundwater remediation system for the removal of DNAPL using steam injection. To ensure that the steam injection system was taking advantage of natural attenuation processes at the site, a compound specific isotope analysis (CSIA) and geochemical evaluation was performed to quantify the intrinsic degradation, identify the mechanisms, and determine the effect of heating on groundwater chemistry was implemented. This study identified: 1) that the intrinsic degradation process was abiotic in nature; 2) mineral precipitate was to be expected during heating; and 3) the impact of the partial pressures of dissolved gases on treatment system operations so that design and operation activities would be prepared to address these issues.

**Evaluation of Remediation Progress for DNAPL Removal in Australia. Confidential Automotive**

**Supplier.** Client requested development of a program to determine the effectiveness of an existing in situ chemical oxidation treatment for a former plant in Australia. ERM implemented a program consisting of sampling both on and offsite for CSIA and water chemistry to assess effectiveness of treatment. The CSIA analysis showed the presence of offsite sources that were mistakenly interpreted to have originated from the client's former factory. From this, the remediation program was discontinued and a no further remediation determination was initiated.

**Monitoring of Electrical Resistance Heating System, Indiana. Confidential Industrial Client.** Client is critically evaluating the use in in situ thermal treatment methods to remove contingent liabilities for environmental restoration from their balance sheets. The geochemical changes that occurred were monitored as to how these changes impact the treatment. ERM established a monitoring program that included CSIA, water chemistry, dissolved gas analysis, and geochemical modeling. Study determined that contractors are not taking full advantage of the reactions taking place and in some cases operating procedures are in conflict with the changes that occur. From this, changes to operations were recommended to the client that are expected to result in more efficient, less energy intensive operations.

**Electrical Resistance Heating (ERH) DNAPL Remediation. Confidential Electronics Manufacturer, Illinois.** As part of plant decommissioning activities, 1,1,1-trichloroethene DNAPL was discovered. To cost-effectively remediate the impacted soils and groundwater, treatment using heat-enhanced hydrolysis, biodegradation, and based on fractional distillation theory was designed to minimize the power requirements. Testing of the groundwater included CSIA, general water chemistry and dissolved gas analysis. This resulted in a cost savings from approximately \$6M to \$1.3M based on contractor estimates.

**CSIA Data Interpretation, Confidential Client.** Project manager and technical lead on compound specific stable isotope analysis. Client was being pursued as major PRP for releases of trichloroethene to groundwater. Differentiated sources of trichloroethene from manufactured sources and that resulting from

breakdown of perchloroethene. Differentiated sources of perchloroethene. Was able to distinguish mixing from multiple sources to determine client's relative contribution to groundwater pollution and hence limit his liability.

**Remediation of lead and polycyclic aromatic hydrocarbon impacted soils, Freeport, IL, Confidential Tire Manufacturer.** Project Manager for cleanup of lead impacted soils from shooting range. Prepared the necessary plans and permit applications for approvals from IEPA and USACE.

**Lead shot removal from a wetland, Akron, OH, Confidential Tire Manufacturer.** Served as Project Manager for a skeet and trap shooting range cleanup. Innovative financing for project involved contractors foregoing project margin to receive a share in the profits derived from the lead reclamation. Project involved physical removal of sediments and lead, testing both wet and dry separation processes to separate the lead from the organic muck.

**Re-engineering of existing groundwater pump and treat remediation system, Upstate NY, Confidential Chemical Manufacturer.** Provided technical direction for the re-engineering of existing groundwater pump and treat remediation system that was ineffective to an approach involving the use of zero valent iron for source control coupled with natural attenuation. Prepared conceptual design of remediation system. Reviewed pilot test data, in particular hydrogen generation information to evaluate geochemical reactions in the subsurface and cleanup.

**Land Treatment of Dredged Contaminated Sediments, Superior, WI, Confidential Client.** Permitted land treatment of coal tar contaminated sediments recovered river dredging operations. Was able to permit land treatment without need for fugitive emission controls based on literature from other land farm and dredge operations.

**Design of Permeable Reactive Barrier, Northern Maine, Confidential Electronics Manufacturer.** Reviewed data from remedial investigations, oversaw laboratory testing and prepared design for a permeable reactive barrier to treat perchloroethene, trichloroethene, and arsenic.

Believed to be the first application of a zero valent iron wall for the treatment of arsenic. Permitted and provided technical support to dredging contaminated sediments from the river adjacent to the plant.

**Design of Permeable Reactive Barrier, Northern Georgia, Confidential Latex Manufacturer.** Reviewed existing monitoring data from groundwater pump and treat system that was ineffective in achieving cleanup goals. Collaborated on the development of conceptual remedial designs, and provided input for design investigation. Design investigation confirmed site conceptual model, and permeable reactive barrier installed.

**Plant decommissioning and in situ thermal DNAPL remediation, Skokie, IL, Confidential Electronics Manufacturer.** This is believed to be the first agency-approved successful in situ DNAPL cleanup of chlorinated solvents from below the water table. Designed and implemented subsurface investigation programs to determine the nature and extent of contamination resulting from plant activities. Performed geophysical and soil vapor surveys to map extent of contamination. Oversaw removal of underground storage tanks. Designed and implemented in-situ groundwater remediation system utilizing innovative biological and thermal techniques for the remediation of chlorinated solvent DNAPL. Process was patented. Obtained a no further remediation letter from Illinois EPA. Investigated the use of chlorine and carbon isotopes with Argonne National Laboratory to define biodegradation half-lives and biodegradation end-products for the purposes of confirming natural attenuation of residual concentrations in groundwater.

**DNAPL Removal, Northlake, IL, Confidential Electronics Manufacturer.** Soil and groundwater clean up. Second application of the patented DNAPL soil and groundwater clean up technology. Implemented in September 1995 and removed chlorinated hydrocarbon at a rate 50% higher than the first site where this was applied as a result of improvements made to the process. Began closing down portions of remediation system after reaching Illinois Tier 1 objectives in just 16 months. Active remediation complete in 1999.

**Bioremediation of soils containing cyanide plating solutions. Confidential Electronics Manufacturer,**



**Nebraska.** Client suspected a leak in their plating solution transfer lines and plating storage tank, located below grade beneath their factory. The extent of impacted soil and groundwater was determined. Samples of soils and groundwater were obtained for bench scale treatability testing. A number of different biological reagents were tested to determine biodegradation feasibility. The treatability testing showed that the indigenous soil bacteria utilized the nitrogen component of cyanide (CN<sup>-</sup>). From the testing a mixture of water, karo syrup, and nutrients to support bacterial growth was developed. To introduce the mixture, an infiltration gallery consisting of mixing tanks, pumping systems fluid distribution systems and a groundwater pumping system for hydraulic control was designed procured, installed, tested and operated for approximately 1 year, achieving cleanup.

**Permeable reactive barrier treatment, Western Missouri, Confidential Electronics Manufacturer.** Utilized geophysical (seismic, resistivity, induced polarization and mise-a-la-masse) techniques, strontium, chlorine and carbon isotope tracers, and passive soil vapor techniques to investigate fractured bedrock system. Developed remediation system based on natural attenuation and source removal.

**Groundwater Remediation, North Carolina, Confidential Electronics Manufacturer.** Responsible for overseeing operations of a 200 gpm groundwater treatment system. Discovery of LNAPL at biovent treatment area resulted in modification to bioslurping. Reviewed existing system and helped develop specifications to modify system. Bioslurping system removed LNAPL in approximately 90 days.

**Groundwater Remediation, Ohio, Confidential Electronics Manufacturer.** Responsible for groundwater investigation and designing interim measures for protecting nearby municipal well field. Conducted NPDES permitting and agency negotiations. Developed pump-and-treat remedial program and monitored clean up.

## Hydrogeologic Investigations

**Soil and Groundwater Investigation, Chemplex Superfund Site, Iowa, Confidential petroleum and Chemical Manufacturer.** Well installation program. Directed downhole testing, core logging, and groundwater modeling. Interpreted results and developed comprehensive site model of site stratigraphy, geohydrology, and DNAPL fate and transport. Developed interim and conceptual remedial designs.

**Groundwater stable isotope Investigation, California, Confidential Aerospace Manufacturer.** Hydrogeologic investigation of a former aerospace manufacturer. Investigated groundwater conditions and through the use of strontium, carbon, and tritium tracers, fingerprinted and differentiated groundwater plumes from four sources onsite.

**Hydrogeologic Investigation, California, Confidential Jewelry Manufacturer.** Hydrogeologic investigation of a former manufacturing facility. Directed investigation of groundwater conditions related to the release of 1,1,1-trichloroethane. Successfully demonstrated to the Central Coast Regional Water Quality Control Board that the impacted groundwater was an isolated flow system as defined by faulting in the area and was geochemically different than the waters currently being utilized. Successfully negotiated a no-further-action approach.

**Site Investigation, Michigan, Confidential Major Utility.** Managed site investigation program for 13 former manufactured gas plant locations throughout Michigan. Work involved review of existing data, develop a model for each site's operations, investigation of the process and storage locations, as well as migration therefrom, biotreatability testing of soils from various locations. Biotreatability testing showed a well-acclimated consortium of bacteria capable of degrading the coal tar residues through to benzo (a) pyrene within a period of one month in the laboratory.

## Decommissioning of Manufacturing Facilities

**Underground Storage Tank Removal, Illinois, Confidential Electronics Manufacturer.** Prepared specifications for the removal of underground storage tanks and for a water well abandonment. Successfully negotiated regulatory variance. Delineated and

interpreted data from investigations for subsurface organic and inorganic compounds.

**Site Closure, Illinois, Confidential Petrochemical Manufacturer.** Prepared an environmental assessment to prepare for the closure of industrial facility. Investigation included asbestos, PCBs, soil and groundwater contamination.

## Expert and Factual Witness Testimony

**Litigation Support, Opinion Paper, Carlsbad, CA, Confidential Law Firm, San Diego, CA.** Using existing data generated for the site through a series of soil and groundwater investigations, Mr. Smith developed a position paper to identify the source of releases of perchloroethene associated with a former dry cleaning operation.

**Expert Witness Testimony, Michigan, Confidential Law Firm, Washington, D.C.** Provided expert witness testimony for both deposition and trial in Federal Court on transport and fate of chlorinated aliphatic DNAPL compounds from a release at a manufacturing site in southwestern Michigan.

**Factual Witness Testimony and Expert Support, Confidential Client, Chicago, IL.** Provided factual witness testimony in deposition on the remediation activities performed at a large industrial location in Cicero, IL. Provided support to expert witness and counsel.