

Paul D. Boehm, Ph.D.
Principal Scientist and Group Vice President

Professional Profile

Dr. Paul D. Boehm has overall responsibility for Exponent's Environmental business. During 34 years of consulting he has advised industrial, legal, and government clients on scientific matters involving many aspects of environmental, analytical, and forensic chemistry as well as petroleum chemistry and natural gas geochemistry. He is a leading practitioner and a recognized expert in the fields of environmental (chemical) forensics as applied to site and sediment investigations; and natural resource damage assessments (NRDA) for oil spills and contaminated sites. Many of his projects involve aspects of historical reconstruction of chemical releases; chemical fingerprinting; divisibility and apportionment; and chemical exposure and injury assessment. His extensive knowledge of the strategic application and practice of environmental forensics has been applied to numerous cases involving complex environmental liability and litigation matters at petroleum operations and manufactured gas plant (MGP) sites.

Dr. Boehm is well-known internationally in the field of marine pollution and oil spill scientific assessment with specific emphases on environmental aspects of contaminated sediments, spill response, and NRDA. He has published extensively on the fate and effects of many major oil spills in the United States, Europe, and the Middle East (e.g., *Amoco Cadiz*; *Haven*; *Ixtoc 1*; *Exxon Valdez*; Arabian Gulf War spill; *Deepwater Horizon*). His work in the NRDA arena goes well beyond oils spills as he has been engaged in numerous cases at CERCLA and State sites, where he has provided expert technical support on exposure and injury assessment; the determination of baseline or background; divisibility and apportionment of contamination, including the applicability of CERCLA's "petroleum exclusion."

His work as an analytical, environmental, and geo-chemist has involved petroleum hydrocarbons – crude oils, refined fuels, and fuel additives – polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), other chlorinated organics, solvents (TCE, PCE), and metals. As a natural gas and petroleum chemist and geochemist, he has also investigated geochemical aspects relating to the migration of natural gas from storage fields and other gas operations.

Dr. Boehm's work has focused extensively on oil refineries, fuel terminals, oil pipelines, and offshore platforms; manufactured gas plants (MGP); land and sediment Superfund sites; and pulp and paper mills. He has published extensively on forensic approaches to investigations at these facilities.

Dr. Boehm has been appointed to serve on several national panels on environmental/ marine pollution and has served on several National Research Council panels.

Academic Credentials and Professional Honors

Ph.D., Oceanography, University of Rhode Island, 1977
M.S., Oceanography, University of Rhode Island, 1973
B.S., Chemical Engineering, University of Rochester, 1970

Publications

Dr. Boehm has published more than 100 papers in peer-reviewed journals and book chapters (listed below) and has written numerous reports (not listed) on petroleum, refined fuels, PAH, PCB, oil spills, marine and terrestrial environmental contamination, chemical fingerprinting, environmental forensics, and impact assessments. He has also written and given more than 100 presentations and published abstracts (not listed) at national and international conferences.

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Prior Experience

Research Leader, Vice President, and Oil and Gas Market Manager, Battelle Science and Technology Inc. (BMI), 2001–2004

Corporate Vice President (1991–2001), Managing Director (1999–2001), and Director (1989–1999), Environmental, Health, and Safety Division, Arthur D. Little, Inc., (ADL), Cambridge, 1989–2001

Senior Research Scientist and Geochemistry Section Manager, Battelle Memorial Institute (BMI), Duxbury, MA, 1983–1989

Principal Scientist, Energy Resources Company (ERC0), 1976–1983

Project Experience

Dr. Boehm has helped clients apply appropriate environmental chemistry methods and advanced chemical fingerprinting strategies (PAHs, PCBs, petroleum hydrocarbons, chlorinated hydrocarbons (TCE, PCE), metals) to problems related to environmental contamination in the context of environmental claims, cost recovery and apportionment, divisibility, toxic tort (exposure) cases, property and product damage claims, transactions, and research studies.

He is a recognized expert on marine and other aquatic oil spills and the conduct of natural resource damage assessments. He has provided technical and expert work relating to the fate, transport, and effects of petroleum, PAHs, PCBs, and other chemicals in natural resource damage assessments; contaminated sediment assessments; surface and groundwater investigations; remediation cost recovery cases, property transfers; maritime cases; medical exposure cases; gas storage field cases; and Clean Water Act violations.

His project work has included natural resource damage assessments (NRDAs) in the Gulf of Mexico, Commencement Bay (WA), Grand Calumet River (IN), New York Harbor/Arthur Kill (NY/NJ), Lake Depue (IL), Delaware Bay (PA), Kalamazoo River (MI), the *Exxon Valdez* (Prince William Sound) oil spill, and the Bayway/Bayonne Refinery cases (NJ). Consulting and expert testifying assignments have included strategic assessments and overall technical strategy development, injury assessment programs, historical reconstruction of contamination histories, chemical consulting, and publication development.

Current or Recent Cases

- Deepwater Horizon: consulting on environmental and NRDA matters (Gulf of Mexico)
- *Exxon Valdez*: testifying expert for defense on NRDA, reopener, environmental forensics, and chemical persistence issues (Alaska)
- Testifying expert for third party defendant on PAH sources on case alleging disposal of manufactured gas plant (MGP) wastes in residential area (Rhode Island)
- Consulting expert on cost allocation of petroleum and related contamination at fuel terminal/manufactured gas plant (MGP) site in Astoria OR
- Contaminated sediments (PAH): testifying expert in allocation and apportionment of petroleum contamination from fuel terminals (Portland Harbor, OR)
- Testifying expert for defense on Superfund site regarding applicability of petroleum exclusion to site issues (Oklahoma)
- Testifying expert for defense on apportionment at historical petroleum refinery (Oklahoma)
- Expert on chemical fingerprinting of fuels in the investigation of the timing of fuel releases at multiparty service station site (Texas)
- Expert in chlorinated solvents (TCE, PCE, TCA) case at manufacturing facility concerning release date(s) and sources (Illinois)
- Expert on a Superfund site for one responsible party to determine divisibility of mercury contamination and remediation costs (Massachusetts)
- Testifying expert for defense on PCB fingerprinting and source determination case in industrial waterway (Washington)
- Expert on PCB matters concerning paper mill inputs to Kalamazoo River (Michigan)
- Testifying expert on fuel oil contamination release and age-dating of hydrocarbon contamination at residential site (Long Island, NY)
- Consultant and testifying expert on *Prestige* oil spill case (Spain) related to fate modeling and shoreline impacts (New York; Spain)
- Technical Review Panel, PPSC Contract, Kuwait National Focal Point for the Kuwait Environmental Remediation Program, set up in Response to UNCC Decision 258
- NRDA at Bayway and Bayonne refineries: testifying expert for defense on contamination reconstruction, chemical forensics , and groundwater (New Jersey)
- Hylebos Waterway (Tacoma, WA): testifying expert (PAH sources and forensics) for defense on apportionment of contamination on remediation cost recovery case (Washington)
- Testifying expert for plaintiffs on PAH sources on case alleging disposal of manufactured gas plant (MGP) wastes in residential area (Rhode Island)

- Apportionment and cost allocation at major U.S. refinery: testifying expert for defense on petroleum products contamination reconstruction and chemical forensics (Pennsylvania)
- Contaminated sediments (PAH): testifying expert in allocation and apportionment of petroleum contamination from fuel terminals (Portland Harbor, OR)
- Arbitration (Institute for Conflict Prevention and Arbitration): testifying expert in allocation and apportionment of petroleum contamination (diesel fuels, gasoline) at fuel terminal (Michigan)
- PAH and petroleum expert on fuels: terminal NRDA case regarding extent of sediment contamination in Penobscot River (Maine)
- Testifying expert on MGP site in concerning characterization of multiple coal tar sources and contribution to sediments (Washington)
- Natural Gas Storage Field Geochemical Fingerprinting (Tioga Field): geochemical expert for operator on sources of natural gas in drinking water wells (Pennsylvania)
- Natural Gas Storage Field Geochemical Fingerprinting (Cunningham Field): geochemical testifying expert for plaintiffs on natural gas escape case (Kansas)
- Natural Gas Storage Field Geochemical Fingerprinting (Elk Basin): geochemical testifying expert for plaintiffs on natural gas escape case (Wyoming)
- Medical exposure: testifying expert for defense on chemical characterization and dose reconstruction on petroleum product exposure case (Southeast US)
- Hurricane Katrina Class Action: testifying expert for defense on environmental matters regarding oil spill transport, fate, and impacts (Louisiana)
- Mohawk River Hazardous Waste Site Delisting: testifying expert for defense on PCB site delisting petition (New York State)
- Supertanker Oily Water Separator Discharge: chemical expert for defense on criminal action under MARPOL regarding alleged oil discharge (California)
- LNG: Co-PI for study of environmental impacts of open loop vaporizers on Gulf of Mexico fisheries (for Center for LNG).

Environmental Forensics Investigations

Polycyclic Aromatic Hydrocarbons (PAH)

Numerous investigations on PAH sources, fate, and effects involving sediment and soil contamination. Consulting or testifying expert for investigation of environmental forensics and PAH contamination (petroleum, creosote, coal tars, other combustion sources) and liability allocation cases in Commencement Bay, Washington, Hylebos, and Thea Foss waterways; Seattle (Lake Union); Boston Harbor (Island End River); Prince William Sound, Alaska; New York Harbor. Cases included developing the forensic basis for differentiating PAH sources: petroleum inputs, specific petroleum sources, combustion inputs, and specific combustion/pyrogenic sources.

Conducted investigations and served as testifying expert on PAHs and petroleum for fuel terminal operations as part of Portland Harbor sediments Superfund Site (Oregon).

Conducted investigations and served as testifying expert on PAHs and petroleum for a cost allocation case on the Hylebos Waterway (Washington).

For the American Petroleum Institute, developed a guidance document on the chemistry and risk of PAHs from petroleum sources. The guidance was geared toward the non-scientist.

Conducted research for EPRI, funded by utility industry, on the application of PAH chemical forensics to unraveling the sources of PAHs at MGP, coal tar-contaminated sites. Applied these strategies to MGP sites in Boston Harbor and Commencement Bay.

Led investigations of PAH inputs into Island End River (Boston Harbor), sediment characterization, source determinations (responsible parties).

Consulted on case in U.S. Virgin Islands related to potential petroleum and PAH inputs associated with cable-laying operations.

For a major oil company, conducted PAH source/forensic study to determine extent of the sediment “footprint” of releases from fuel terminal in the Penobscot River, Maine.

Petroleum Chemistry

Performed multiple investigations to characterize petroleum products (fuels and crude oil, and wastes) in soils and groundwater at major East Coast petroleum refinery and terminal (Pennsylvania).

Provided expert chemistry consulting on numerous cases involving petroleum fuels from terminals, pipeline, and refineries including crude oil, diesel fuels, automotive gasoline, lube oils, hydraulic oils, and fugitive emissions.

Served as expert on two petroleum refinery cases in Oklahoma involving examination of applicability of “Petroleum Exclusion” under CERCLA.

Testifying expert on transactional dispute regarding petroleum fuels (gasoline, diesel fuels) terminal in Michigan, to determine sources and relative age of in-ground petroleum contamination.

Expert on hydraulic fluids in case to determine chemical composition and dose involving contamination of surgical instruments.

Provided expert support on several maritime pollution cases dealing with alleged oil tanker and cruise ship discharges of oil and MARPOL and Clean Water Act violations in Alaska, the Pacific Ocean, Florida, and Bermuda.

Served as principal investigator and prime contractor to Chevron's worldwide environment functional team for oil spills. Led the environmental chemistry/NRDA team, and developed training materials on appropriate and defensible analytical techniques and measurements.

Developed methodologies and guidance for investigation and chemical characterization of oil spill fates and effects for NRDA and forensic investigations for multiple clients.

Polychlorinated Biphenyls (PCBs)

Began conducting studies of PCB distribution in coastal marine environments with Ph.D. work on PCB determination in sediments of Rhode Island Sound.

Conducted environmental monitoring studies for NOAA and EPA

- Boston Harbor organic contaminants (ca. 1984)
- NY Harbor and Bight studies (ca. 1986)
- Status and Trends mussel watch program (congeners vs. Aroclors)
- EPA Ocean Dumping and Ocean incineration of hazardous wastes (1983-1986)
- PCB analyses of samples from New Bedford Harbor (Superfund Site studies)
- PCB analyses of samples from Palos Verdes shelf (NRDA).

Conducted PCB investigation as part of hazardous waste site delisting petition on the Mohawk River (New York).

Testifying expert on PCB apportionment case at Slip 4 Duwamish River (Congener fingerprinting) – testified at mediation.

Conducted environmental forensics investigation for client on Delaware River-Mantua Creek (Congener fingerprinting).

PCB fingerprinting investigation of paper mill wastes -Kalamazoo River (Congener fingerprinting).

Chlorinated Solvents

Investigation of source(s) of solvent contamination at manufacturing site in Illinois. Use of chemical and stable-isotope methods to determine number of sources, release dates of plumes, and fate and transport.

Natural Gas Geochemical Fingerprinting

Principal investigator and testifying expert on natural gas storage reservoir case addressing differentiation of storage and native gas in Cunningham Field, Kansas.

Principal investigator and expert on natural gas storage reservoir case addressing possible migration of natural gas from storage field in Tioga Junction, Pennsylvania to drinking-water wells.

Principal investigator and testifying expert on natural gas storage reservoir case addressing differentiation of storage and native gas in storage field in Wyoming, to determine escapement of storage gas from geological reservoir.

Principal Investigator and geochemical expert on natural gas storage reservoir (Fink-Kennedy-Lost Creek (FKLC) storage pool) to determine relationship of gas from storage field to that in private lease.

Natural Resource Damage Assessments

Conducted numerous investigations – offshore water and sediments; shoreline (marsh) biodegradation; chemical fingerprinting - regarding NRDA in the Gulf of Mexico as part of the Deepwater Horizon blowout.

Served as testifying expert on *Exxon Valdez* oil spill related to NRDA and other environmental claims.

- Responsible for shoreline ecology assessments, transport and fate, chemical forensics and baseline determinations, impact and recovery monitoring, and ecological risk assessments.
- Served as a senior advisor on analytical and chemical fate issues during the *Exxon Valdez* spill response and longer-term assessment, coordinating the development of chemical data by 16 laboratories nationwide.
- Served as program manager of shoreline ecology studies in Prince William Sound following the spill.
- Led the *Exxon Valdez* chemical fingerprinting and allocation studies in Prince William Sound.
- Served as one of a select group of outside scientific advisors/consultants consulting on environmental chemistry, long-term effects and risks, and definition of the chemical baseline (www.exxonmobil.com/corporate/Newsroom/NewsReleases/Corp_NR_Expert.asp).

Technical expert and lead chemist on northeast U.S. refinery and terminal sites (Bayway and Bayonne) against claim for natural resource damages—chemical forensics, historical reconstruction, and groundwater.

NRDA at fuels terminal in Maine—determination of extent of contamination from terminal to Penobscot River sediments.

Provided NRDA consulting on CERCLA sites: Commencement Bay, Grand Calumet River, Lake Depue, Delaware Bay, Kalamazoo River. Consulting assignments included strategic assessments and overall claim strategy development, injury assessment programs, expert consulting, report, and publication development.

Technical consulting related to Exxon Bayway (1990) oil spill into Arthur Kill and New York Harbor. Work involved baseline development and chemical basis for injury assessments.

Developed technical basis for claims to the United Nations Claims Commission with regard to environmental (NRDA) damages from the 1991 Gulf War. Helped set up in-country laboratories used for Saudi PME-funded studies.

Conducted the first international NRDA study for the Italian Environmental ministry (ENEA) research group concerning the environmental transport, fate, and effects of oil spilled from the tanker *Haven* off the coast of Genoa, Italy.

Developed technical basis for NRDA claims for the *Katina P* oil spill in Mozambique.

Consultant on chemical and toxicological matters to Protection and Indemnity (P&I) Clubs for Cosco Busan (San Francisco Bay) and M/V Selendang (Alaska) oil spills.

Principal Investigator on review and critique of Type A NRD/CME model for oil spills (OPA 90) for the American Petroleum Institute.

Principal Investigator on review and critique of Type A NRD/CME model for contaminated sites (CERCLA) for an Industrial Consortium.

Manufactured Gas Plant (MGP) and Related Coal Tar Experience

Retained as expert for allocation of contamination at MGP plant – fuel oil terminal in Astoria Oregon

Retained as PAH forensics expert to investigate sources of PAHs in residential neighborhood (Bay Street, Tiverton, RI) as a result of complaint filed by residents alleging MGP waste disposal from a major MGP works.

Retained as PAH forensics expert to characterize the PAHs in multiple source related to various MGP processes at a major MGP site in Seattle and to unravel multiple sources of PAH contamination to surface sediments adjacent to the site.

Retained as PAH forensics expert to provide expertise to characterize PAHs in MGP coal tar and to differentiate MGP coal tar PAHs from other pyrogenic PAHs entering the Thea Foss

Waterway and to apportion responsibility for PAH contamination between utility and City of Tacoma. Developed site-specific fingerprinting and PAH allocation strategy.

Retained as PAH forensics expert by attorneys for a MGP site in Boston Harbor, Island End River, to develop and conduct the first source investigation of PAHs from the MGP facility and other sources to heavily contaminated sediments.

Served as consulting PAH expert (Director-in-Charge of case) at the Frola (Edgewater NJ) site (now the Quanta Resources NPL Site) to characterize PAHs in upland soils and to determine origin of PAHs in the soils - coal tar processing or a petroleum recycling/storage origin.

Developed MGP coal tar chemistry chapter for EPRI's Sediment Compendium. Developed chapter devoted to history of MGP plants, MGP product chemistry, and environmental forensics methods.

For EPRI, Co-Principal Investigator on research project that resulted in the publication of "Identifying PAHs from Manufactured Gas Plant Sites." Included aspects of MGP waste and product chemistry and environmental forensics methods to distinguish coal tar from other PAH sources.

Oil Spill Research and Consulting

Principal Investigator of multiple oil spill fate and effects studies and major assessments, including studies of the *Exxon Valdez*, Exxon Bayway Refinery (NJ), Shell Martinez Refinery (CA), Ashland (Monongahela River) spill, 1991 Gulf War oil spill, *Argo Merchant (Georges Bank, MA)*, *Amoco Cadiz (France)*, *Ixtoc 1 (Gulf of Mexico)*, *Tsesis (Sweden)*, *Haven (Italy)*, *Katina P (Mozambique)*, *North Cape (RI)*, and *Prestige (Spain)* spills, among others. Spills involved crude oils and fuels (heavy industrial oil, bunker oils, diesel fuel, and gasoline).

Principal Investigator for Environment Canada on multiyear study of effects of chemically dispersed and non-dispersed oil in the Arctic, the Baffin Island Oil Spill Study (BIOS).

Served as Technical Expert for U.S. Minerals Management Service in a formal review of oil spill impact models available internationally. MMS project title: Survey of Marine Environmental Impact Assessment Models.

Served on expert committee of the National Research Council's Marine Board and coauthored review of the U.S. Coast Guard's Interagency R&D plan, inclusive of oil spill trajectory modeling for National Research Council.

Prime contractor and technical expert for Chevron on their oil spill environmental functional team. Prepared "EFT Response Manual" and "EFT Response Guide," including section on spill trajectory modeling and oil spill surveillance. Participated in four spill drills involving the use of trajectory modeling and other tools. Advised response team on use of these tools.

Principal author of background chapter on Physical and Chemical Fates in *Oil in the Sea*, National Academy of Sciences, 1985.

Liquefied Natural Gas (LNG) Assessments

Principal Investigator on Center for LNG-sponsored assessment of the environmental impacts of open-loop vaporization technology for LNG projects in the Gulf of Mexico.

International Environmental Impact Assessments

Led environmental impact assessment programs and EHS management systems reviews of oil and gas operations in Latin America (Colombia and Venezuela), West Africa (Nigeria, Angola), the Former Soviet Union (Caspian Sea), and throughout North America.

- Onshore and offshore EIAs for gas expansion projects in the Escravos region, Niger Delta, Nigeria
- Environmental baseline studies in Angola
- Environmental baseline studies and EIA support for offshore development, Caspian Sea
- Environmental baseline studies and EIA support for offshore development, Caspian Sea
- Advisor for West African gas Pipeline EIA and EBS programs in Nigeria, Togo, Benin, and Ghana
- Senior reviewer and advisor for seismic EIA for oil company consortium in Northeast Caspian Sea (now OKIOC)
- Director-in-charge of EHS and social audit and management systems assessments.

Developed environmental management, monitoring, and risk assessment strategies for offshore (Sonda Campeche) and onshore (Chicontepec) oil field developments. Work included advising on the development of environmental management plans for long-term development of these fields.

Led the development of a technology transfer program for the Instituto Mexicano del Petroleo involving: creation of a state-of-the art analytical chemistry facility, development of an environmental forensics capability, advancement of environmental management information systems, and development of capability for integrated environmental impact assessment.

Reviewed EHS management systems related to pipeline and processing operations in Colombia. Performed audits and made recommendations to senior managers.

Oil Exploration and Related Drilling Discharges

Conducted numerous investigations for API and the U.S. Offshore Operators Committee on chemical method for analyzing discharges of lignosulfonate muds and drill cuttings in Gulf of Mexico.

For MMS, managed risk assessment study of the chemical used in deepwater exploration and production operations in the Gulf of Mexico.

For API, conducted studies on the chemical characterization of oilfield produced waters in the Gulf of Mexico.

Risk Assessments

Managed and directed a 3-year ecological risk assessment of the Bayway (New Jersey) refinery and Bayonne terminal. Work also included numerous forensics investigations at the sites, in adjacent waterways, and other areas related to the sites.

Conducted and published an ecological risk assessment of the *Exxon Valdez* spill on mussel populations and foraging wildlife in Prince William Sound, Alaska.

Pollution Monitoring

Served on a team contracted to the Kuwait Institute for Scientific to assist in the development of their coastal monitoring and oil pollution research program. This included development of laboratory and field capabilities.

Led numerous marine programs for the U.S. Department of the Interior's Bureau of Land Management and MMS related to assessment of impacts of exploration and production activities and discharges in the Alaskan Beaufort Sea, Shelikof Strait, Cook Inlet, California's Santa Maria Basin, Georges Bank, and the Gulf of Mexico.

As principal investigator, conducted a study of the inventory, usage, and ecological risks of chemicals in deepwater drilling and near-shore exploration and production activities in the Gulf of Mexico, for the U.S. Department of the Interior, MMS. Developed risk-based evaluations of potential impacts of these chemicals on the marine environment.

Served as program manager and principal investigator for various field studies and analyses for EPA's Ocean Dumping/Disposal and Ocean Incineration Programs between 1986 and 1989. Work included major field investigations.

Helped design the Status and Trends-Mussel Watch Program – East and West Coasts, for the U.S. National Oceanic and Atmospheric Administration in 1985–1989. Became Program Manager for the implementation of NOAA's first Mussel Watch program.

Advisory Boards

- Member, Advisory Board, Institute for Energy Law
- National Academy of Sciences/National Research Council committee member on panels addressing marine monitoring systems and design, and oil spill research and development
- National Blue Ribbon Panel, 106-Mile Site Monitoring Program (EPA, NOAA)
- World Business Council for Sustainable Development—Delegate, Climate Change
- Chief EH&S Officer’s Council, The Conference Board
- Board of Directors, Marine Programs Advisory Council, University of Rhode Island
- Peer Reviewer: *Environmental Science and Technology*; *Chemosphere*, *Marine Pollution Bulletin*, *Environmental Toxicology and Chemistry*
- Editorial Board (Former), *Marine Environmental Research*, Elsevier, Ltd.
- Member, Technical Advisory Group for Marine Programs, Secretary of Environmental Affairs, Commonwealth of Massachusetts

Professional Affiliations

- American Chemical Society—ACS
- Society of Environmental Toxicology and Chemistry—SETAC
- International Society of Environmental Forensics—ISEF
- Society of Petroleum Engineers—SPE
- American Association for the Advancement of Science—AAAS
- American Society for Testing and Materials—ASTM
- American Bar Association (associate member)

Deposition/Trial Testimony

Dr. Boehm has given numerous depositions and has testified as an expert witness in State and Federal Court, Administrative Proceedings, and in Arbitrations. Specific details are available on request.