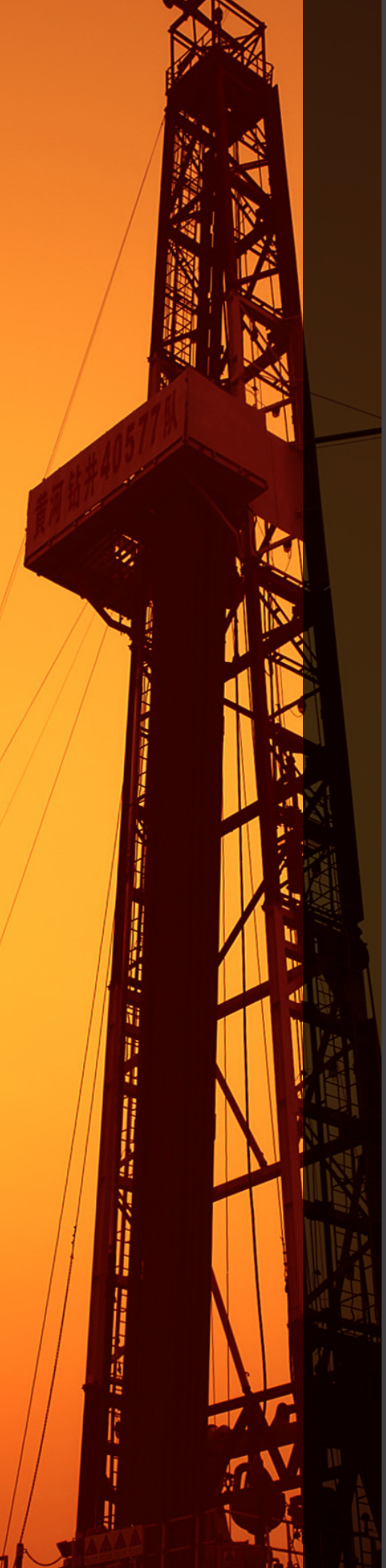
BATTELLE ADVANCED BIOLOGICAL AND CHEMICAL ANALYSIS

CLEAR, OBJECTIVE ANSWERS

BATTELLE

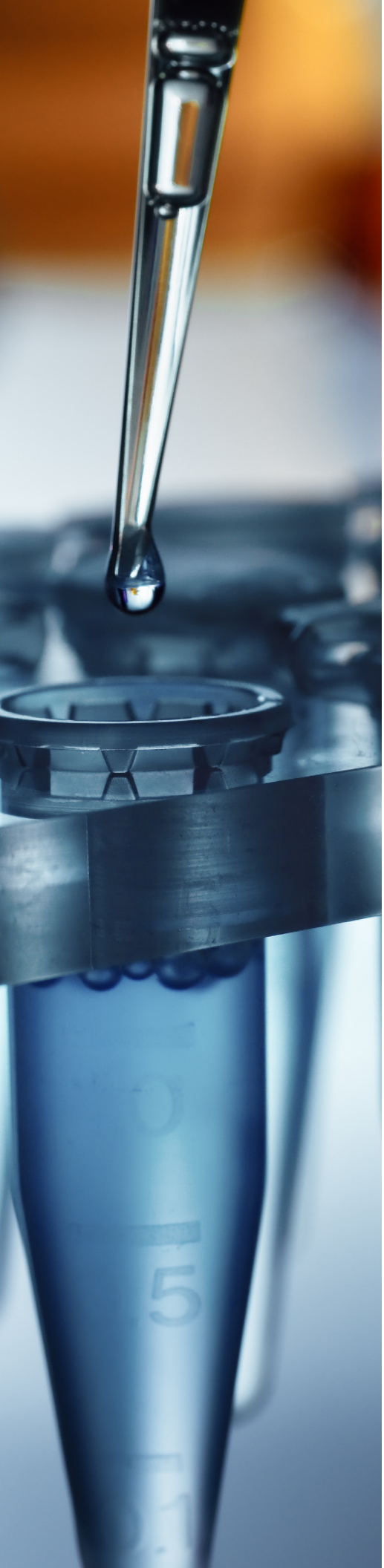


Whether you are responding to a spill or establishing a baseline before you drill, you need accurate, objective answers to control your risks and make effective decisions. Battelle combines industry-leading biological and chemical analytical methods with a deep understanding of the oil and gas industry to give you answers you can trust.

- Baseline studies
- Environmental effects monitoring
- Oil spill response
- Shale gas monitoring
- Forensic identification and source attribution
- NRDA Response

Determining the Source of NAPLs

Non-Aqueous Phase Liquids (NAPLs) were found during monitoring of a well near a pipeline about five miles from an abandoned oil field in California. There was suspicion that an inactive crude oil trunk line from the Brentwood Oil Field may have been leaking at some point in past. The client needed to know if NAPLs found in the well were from the oil field five miles away, or from other sources. We used a variety of forensic methods to characterize the compounds – including saturated hydrocarbon, polycyclic aromatic hydrocarbon, and petroleum biomarker analysis – to accurately fingerprint the NAPLs at the well and from the abandoned trunk line. By comparing the samples, we were able to determine with confidence that the NAPLs found in the well came from natural sources unrelated to the abandoned oil field, releasing the oil company from liability.



All the answers you need,

Petroleum Chemistry

For more than 25 years, we have gone beyond the standard to provide the oil and gas industry with industry-leading methods in petroleum chemistry. We bring the latest scientific discoveries and technologies to the industry for highly accurate data even in complex or challenging conditions.

- PAH/alkylated PAH
- Petroleum biomarkers
- SHC/TPH
- Alkylated phenols
- PIANO
- Dispersants/surfactants
- Glycols
- SARA

Advanced Analytical Chemistry

From routine studies to unique challenges, we offer a broad range of analytical methods, including GCxGC TOF MS and GC-PFPD.

Hydrocarbon Fingerprinting

Battelle's unique laboratory and research facilities employ biomarker and other high resolution analysis as well as chemometric capabilities to support advanced hydrocarbon composition analysis, toxicology studies, WAF/CEWAF studies, ecological risk assessment, fingerprinting and source attribution.

Chemometrics

Our chemometrics team applies advanced computational and statistical methods to solve some of today's most difficult analytical challenges. We use advanced statistical analysis to identify key relationships between samples and oil sources to determine if there is a match and its strength.

Analytical Chemistry Method Development

If the right method doesn't exist, we can develop and validate one for you. We are working to solve some of the most difficult problems in the industry today through scientific discovery and innovative analytical methods.

Advanced Biology

Understand the effects of oil & gas development activities on biological systems, from the DNA level to the population level. We offer a full range of advanced analytical methods for biology to determine exposure and assess biological impact. We can analyze the entire biological pathway, from chemical/molecular, to cellular, to tissue, to organism, and finally to transgenerational population impact.

all in one place.

- Metagenomics, metaproteomics, metatranscriptomics
- Population genetics
- Genomics, proteomics, transcriptomics
- Physiological biomarkers (cytochrome P450, EROD, etc.)
- Genetic biomarkers (chromosome and DNA damage; micronucleus analysis)
- Evolutionary toxicology

Microbial Biodiversity, Community Structure and Functional Pathways

Accurately assess microbial species and community structure, functional gene pathway expression, and gene pathway regulation. Our microbial genomics team uses metagenomics, metaproteomics, and metatranscriptomics to identify the micro-organisms involved in hydrocarbon biodegradation and the associated metabolic pathways and their regulation with more accuracy than traditional methods allow. We have applied these techniques to shoreline sediments and deepwater.

Environmental DNA

Safely and accurately assess animal biodiversity, from fish to mammals, even in extreme Arctic or deepwater marine habitats. We use molecular genetics combined with eDNA sampling of seawater or marine sediment to reduce the costs and safety risks of biodiversity assessments, while increasing the accuracy of results. We have applied these techniques to determine biodiversity in marine waters and deepwater sediments.

Microbially Influenced Corrosion (MIC)

Accurately assess MIC through an integrated analysis approach. We offer a comprehensive suite of analyses including chemical, physical, and biological to provide a complete view of potential MIC problems through multiple lines of evidence. The resulting integrated solutions allow our clients to understand if an MIC problem exists, which microbes may be causing the problem, what chemicals are causing the corrosion, and intervention options to mitigate the problem.

In Lab Studies and Study Design

We can help you design, conduct and validate a wide range of studies, from complex environmental field studies to routine lab testing. We conduct in-lab experiments to mimic what is happening in the environment, and work with you to help you select the right study for your time, cost and data needs.

Advanced Biology Method Development

We operate at the frontier of advanced biological analysis, developing new methods to answer complex questions and find cost-effective alternatives to traditional field techniques. From AUV technology with automated water sampling for eDNA analysis, to user-friendly bioinformatics tools, to advanced biochemistry for biomarker development, we can find a solution that works for you.

Using eDNA to Control Costs and Improve Safety

We conducted a biodiversity study focused on Arctic fish utilizing environmental DNA (eDNA) for a large oil company and the North Slope Borough of Alaska. Using water samples taken from Elson Lagoon, we were able to isolate DNA and then use multiple molecular analyses to identify the species present in the area.

Species lists of identified organisms were compiled and compared to fisheries catch data and scientific sampling. The molecular methods were shown to not only agree closely with the catch data in terms of species caught, but they also detected fish species not collected by the subsistence fishermen or by scientific sampling. In addition, eDNA detected rare species such as bowhead whales, walrus, and other marine mammals.

Why Battelle?

We are the world's largest independent research and development organization, operating at the forefront of scientific discovery. We provide world-class analytical expertise and rapid response to meet critical needs in the oil and gas industry.

- **Experience:** We are a leader in innovation and environmental services for the oil & gas industry, with decades of experience in field and lab services.
- **Expertise:** We bring together industry-leading expertise in biology, chemistry, environmental services and analytics.
- **Results:** We have a proven track record helping customers in the oil & gas industry boost performance, reduce risk, increase safety and accelerate innovation.

How can we help you today?

Contact us for a free needs assessment.

Every day, the people of Battelle apply science and technology to solving what matters most. At major technology centers and national laboratories around the world, Battelle conducts research and development, designs and manufactures products, and delivers critical services for government and commercial customers. Headquartered in Columbus, Ohio, since its founding in 1929, Battelle serves the national security, health and life sciences, and energy and environmental industries. For more information, visit www.battelle.org.

800.201.2011 | **solutions@battelle.org** | **www.battelle.org**

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It can be done

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