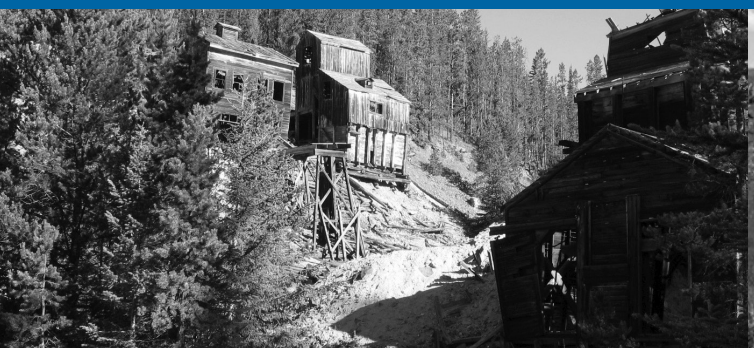
geochemistry services



The potential for chemical impacts to water, soil, and air from industrial operations and construction often requires geochemistry to assess, predict, and manage those impacts. Drawing upon a long history of providing engineering and environmental consulting services, Barr's team of scientists and engineers applies geochemistry to engineering and design, environmental investigation and remediation, and environmental permitting and compliance. To develop focused, cost-effective solutions for clients, geochemistry is considered in the sampling and analysis plan, source characterization, predictive modeling of impacts and mitigation strategies, and data interpretation. Value and meaning from a geochemical program is maximized by using statistical analysis and visualization tools, which Barr applies to our clients' projects based on their needs.

understanding sources leads to effective solutions

Geochemists at Barr assess contaminant sources that may be from a legacy facility or ongoing operations or may be anticipated as potential risks from future projects. To plan and implement a material characterization, we draw upon experience in applying standard or project-specific methods for chemical and mineralogical composition and static and kinetic geochemical protocols, including acid-base accounting, humidity cell tests, and other leaching procedures to characterize leachability or potential drainage quality from the material. Results from the material characterization form the basis for understanding the geochemical release mechanisms that may be necessary to develop effective control strategies. Barr applies expertise in data analysis to identify chemical signatures distinguishing multiple material types and sources of contaminants. Consideration of various contaminant sources may be important in remedial solutions and in apportionment of liability.

Barr designed and implemented a waste characterization plan, including humidity-cell testing and geochemical modeling, for waste rock at a proposed mine.

modeling guides design and demonstrates mitigation

Barr's expertise in geochemistry and surface water and groundwater modeling positions us to develop targeted and cost-effective modeling solutions. Modeling efforts begin with a site conceptual model that focuses on what is necessary for a client's need. It describes the hydrogeochemical environment that controls the mobility of constituents of concern and anticipated changes to that environment through time and space. Processes within the conceptual model may include important chemical reactions representing interactions among water, rock, soil, and air. Models answer questions about travel time and distance and concentrations of contaminants, assess attenuation mechanisms, and predict geochemical reactions when distinct waters mix or interact with other media.

Following a site conceptual understanding, computations may require static geochemical equilibrium calculations, mixing of two or more solutions, a model of geochemical reactions along a one-dimensional flow path, complex two- or three-dimensional water flow and transport modeling, or a simulation of pit lake chemistry. Software typically used includes GoldSim and CHEMCAD to track mass balance and PHREEQC and Geochemist's Workbench to simulate kinetic reactions and equilibrium conditions.

example: acid-generating rock identification and mitigation

A section of state highway in Minnesota was realigned to improve safety and traffic flow. The construction exposed rocks, gravel, and soil containing sulfide minerals that generated acid rock drainage (ARD). Barr worked with the Minnesota Department of Transportation (MnDOT) to implement an acid-generating rock mitigation plan. Mitigation included adjusting lime amendments based on chemical and statistical characterization of excavated material and working with the construction contractor to determine appropriate construction techniques. Our work helped the excavated material remain within the mitigation plan's safety factors for impacts to water quality.

For MnDOT's highway construction project, Barr helped implement an ARD mitigation plan that tested pyrite-laden rock for sulfur, and if needed, mixed it with lime and placed it in fill areas covered with geomembranes to neutralize the potential for acid leachate.

example: metal release characterization to support closure of industrial facility

Barr's geochemistry team supported the closure of an elemental-phosphorus-processing facility located in Montana. Based upon analysis and visualization tools applied to environmental data, contaminants of concern were identified, and plans for further investigation were developed. Barr evaluated the nature and extent of releases from solid-waste management units and areas of concern at the site and generated all the necessary data to support a corrective-measures study. The understanding of arsenic release and its sorption onto the aquifer materials was incorporated in a contaminant-transport model to evaluate closure options.

example: metal leaching assessment and coupling with water balance to support mine site closure

Barr is characterizing the fate and transport of zinc from tailings as part of a closure and reclamation plan for a former zinc and lead mine to minimize or eliminate the need for long-term active water treatment. In-situ water and soil quality probes were installed for monitoring geochemical conditions. Static and kinetic tests were conducted to understand the source of zinc and quantify zinc mobilization. The data were used to understand the process and variables affecting zinc leaching and to estimate the rate of zinc release. Using the GoldSim platform, Barr developed coupled water-balance and fate-and-transport models that incorporated methods for evaluating how metal concentrations in discharge vary in response to closure options.

example: water quality evaluation to support CCR regulatory requirements and management planning

Barr applies geochemistry to coal combustion residual (CCR) storage facilities at power generation sites for multiple clients across several states. Tasks vary to fit the unique needs of each site but often include groundwater monitoring plans, sampling and analysis support, and data interpretation. Barr integrates geochemical characterization with our knowledge of the environmental regulations to help clients comply with the U.S. Environmental Protection Agency's 2015 CCR rule for legacy ash and the management of active landfills and impoundments. Our geochemical expertise supports waste and aquifer characterization, statistical analysis of water-quality data, and determination of the sources of increased concentrations—enabling facilities to avoid costly remediation measures.

Evaluation of contaminant transport and attenuation processes has been applied to assessment of closure options. At a site with a CCR facility sitting atop a relatively shallow, sandy aquifer contaminated with selenium, geochemical analysis was used to estimate the time for cleanup by natural processes following consolidation and covering the material. The analysis showed a reasonable timeframe for cleanup and compliance with water quality standards, which allowed the client to plan for a shortened duration of water treatment.