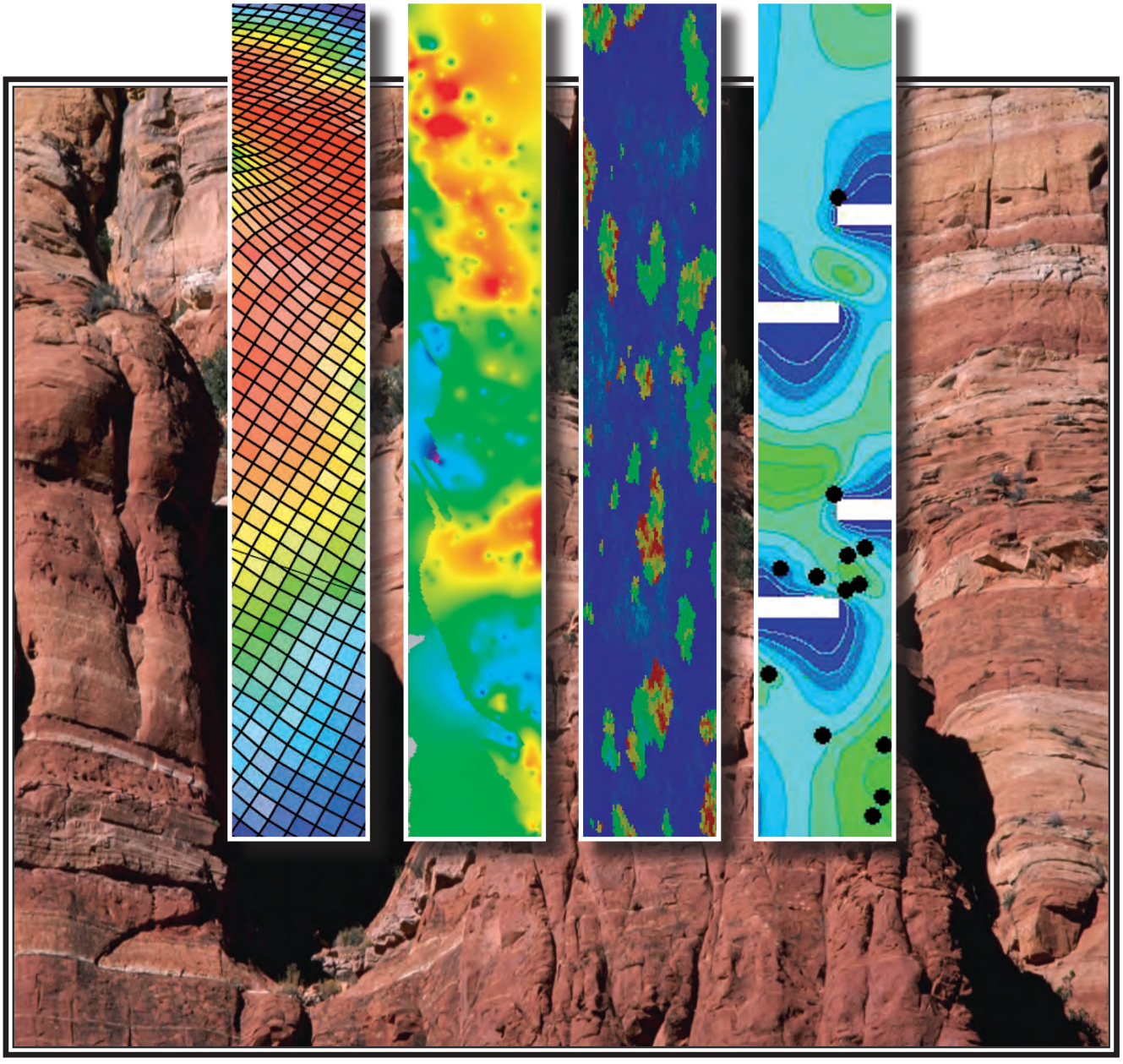
Hydrogeology and Geochemistry Services



Southwest Research Institute®

San Antonio, Texas

Founded in 1947 as an independent, nonprofit research and development organization, Southwest Research Institute® provides a significant research, engineering and testing resource for industry, business and government. With 11 technical divisions, SwRI® uses a multidisciplinary, integrated approach to solving complex problems in science and applied technology. The Geosciences and Engineering Division is internationally recognized for innovative solutions to complex problems in the earth, material and planetary sciences and allied engineering disciplines. SwRI creates multidisciplinary teams to solve client problems within a framework of risk assessment, system studies and regulatory analyses. As part of a long-held tradition, patent rights arising from sponsored research at the Institute often are assigned to the client. SwRI generally retains the rights to Institute-funded advancements.

SwRI researchers examine the spatial patterns of fractured rock and their effects on fluid movement and contaminant transport to develop specialized statistical simulation and flow modeling. Networks of interconnected fractures, such as the oil-filled fractures from a breached oil field in Oklahoma shown here, form the primary pathways for the movement of groundwater, hydrocarbons and even toxic chemicals or radioactive wastes.

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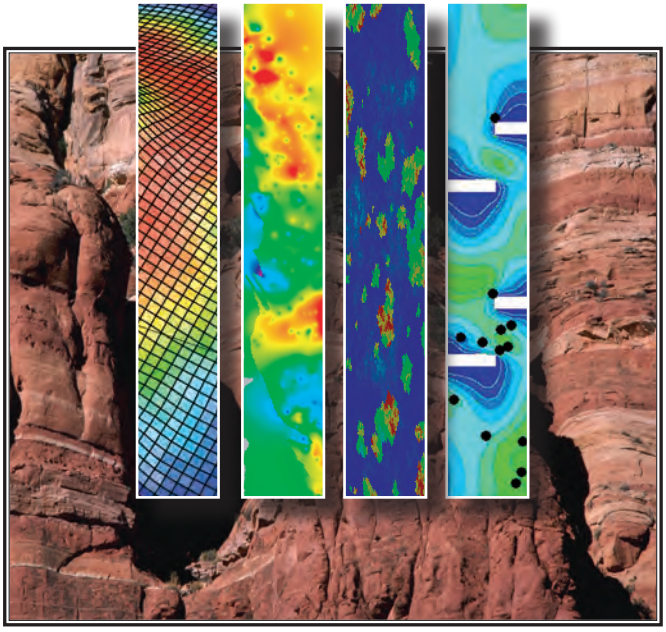


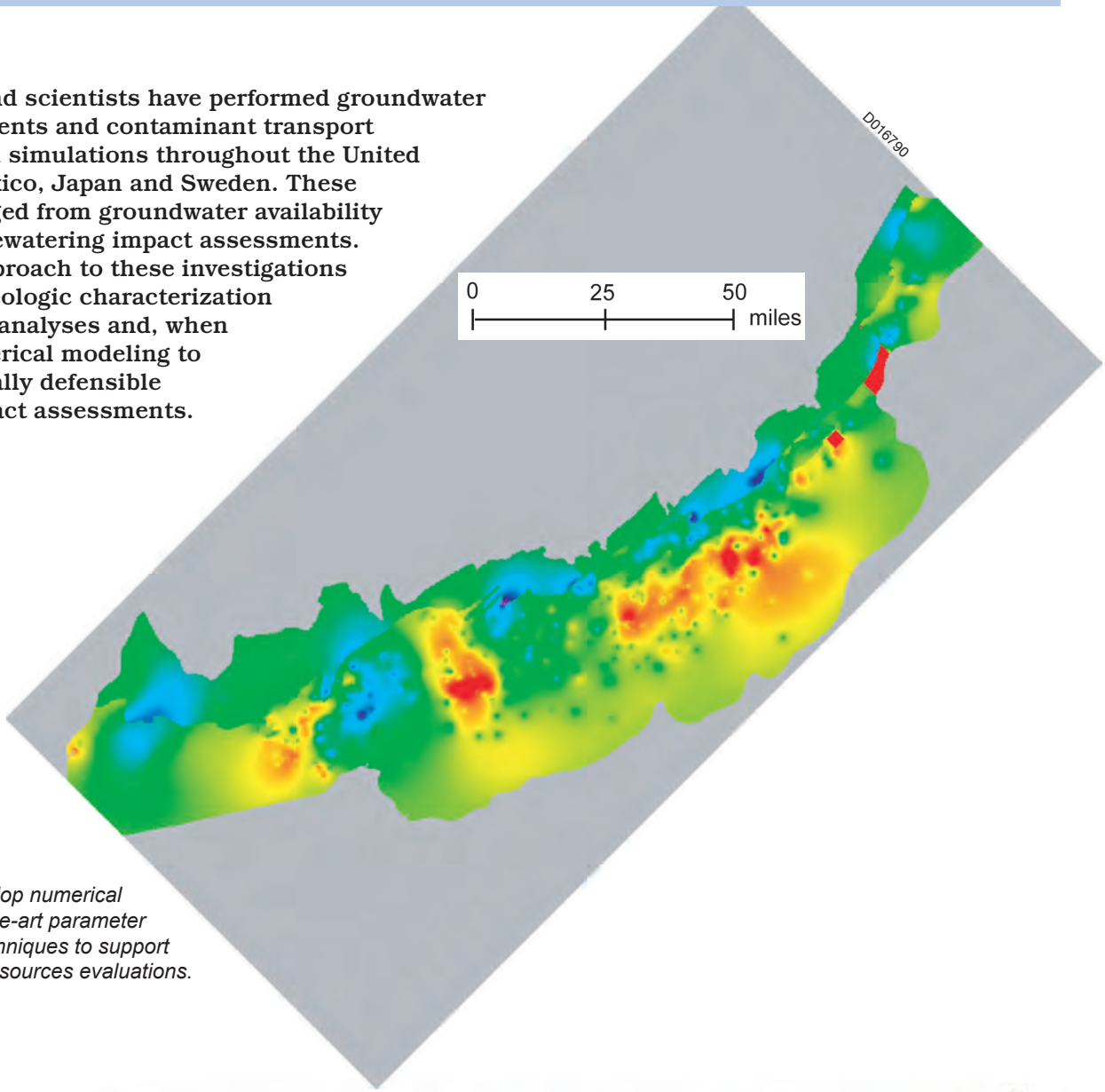
Southwest Research Institute® (SwRI®) provides hydrogeologic and geochemical services ranging from local and regional groundwater supply studies to complex contaminant fate and transport analyses. With sophisticated computational and visualization resources and fully equipped laboratories, Geosciences and Engineering Division (GED) scientists and researchers solve diverse scientific and engineering problems for government and industry.

SwRI assesses and interprets hydrologic flow and the consequent transport of environmental contaminants in diverse geochemical systems. Our technical expertise includes:

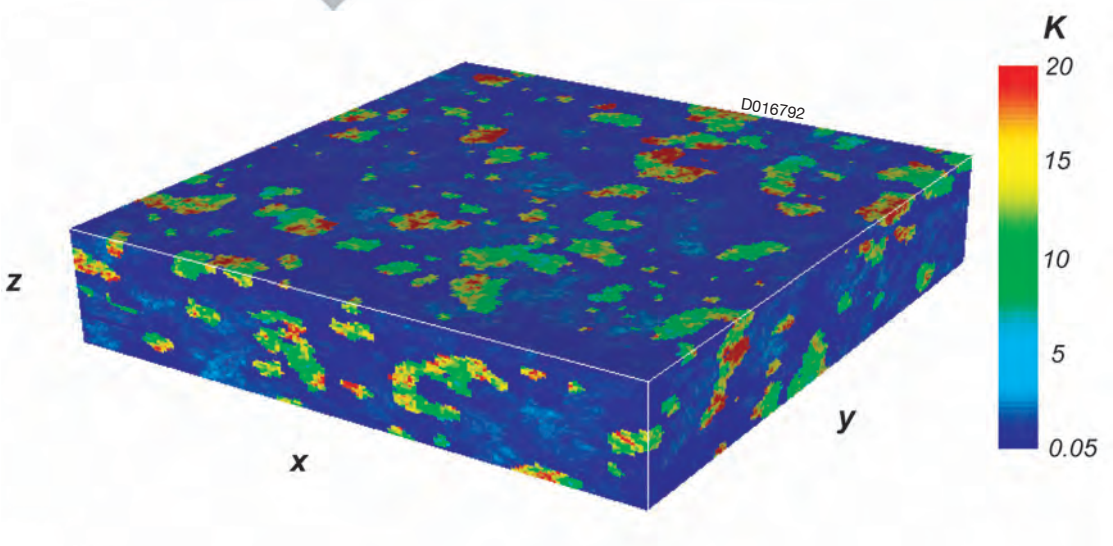
- ❏ Physical and earth sciences
- ❏ Engineering and material sciences
- ❏ Hazard assessment
- ❏ Environmental science
- ❏ Regulatory interpretation, implementation and compliance demonstration

Groundwater Resource Assessment

SwRI engineers and scientists have performed groundwater resource assessments and contaminant transport investigations and simulations throughout the United States, and in Mexico, Japan and Sweden. These projects have ranged from groundwater availability studies to mine dewatering impact assessments. Our integrated approach to these investigations combines hydrogeologic characterization with geochemical analyses and, when appropriate, numerical modeling to develop scientifically defensible resource and impact assessments.



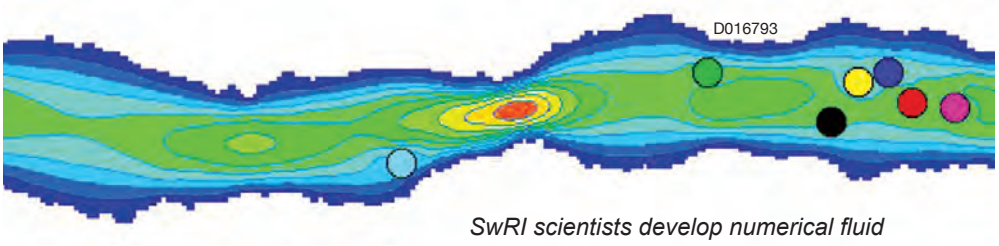
SwRI scientists develop numerical models and state-of-the-art parameter estimation techniques to support groundwater resources evaluations.



Assessments such as this, showing an uncertainty assessment for subsurface flow parameters, are important for constraining transport interpretations.

Numerical Modeling and Code Development

SwRI has particular expertise in numerical simulation of hydrologic and geochemical processes. In addition to utilizing existing codes, Institute scientists have modified or developed original geochemical and hydrologic computer modeling codes to meet client needs in:

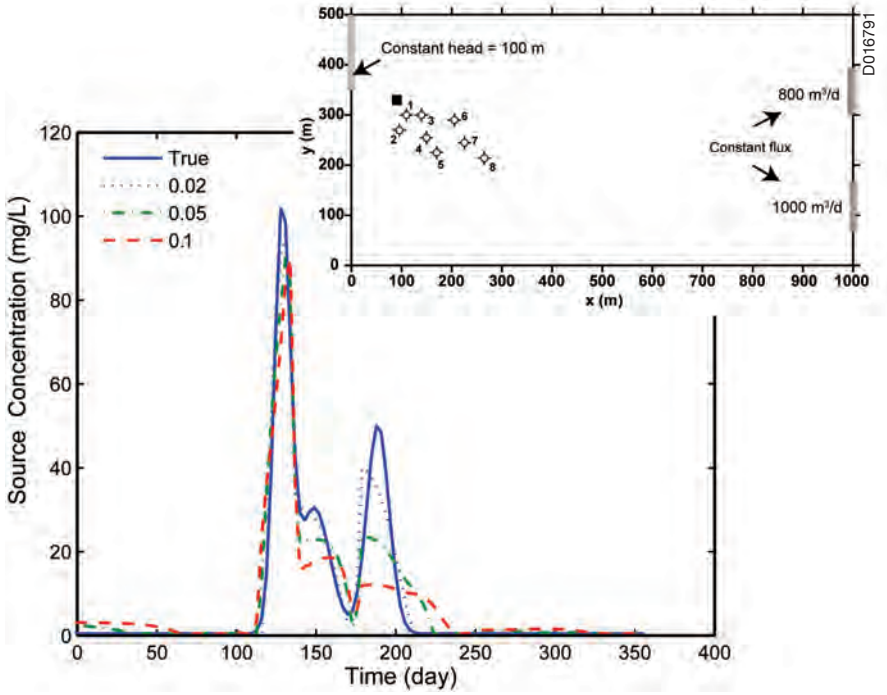


SwRI scientists develop numerical fluid flow models to track particle behavior in heterogeneous systems. Background colors represent different velocity fields, while spherical objects represent particles being transported.

- ❏ Multiphase isothermal and nonisothermal flow modeling
- ❏ Discrete conduit modeling of karst aquifers
- ❏ Reactive contaminant transport analyses
- ❏ Microscale particle transport modeling
- ❏ Infiltration analysis
- ❏ 3-D heterogeneity modeling
- ❏ Groundwater resource evaluations
- ❏ Sorption modeling

Contaminant Source Identification

Model uncertainties can result from inadequate model conceptualization, spatial and temporal variability of model parameters, inaccurate initial and boundary conditions, and errors related to the numerical solution process. CONSID© (Contaminant Source Identification) is an SwRI-developed software toolbox that identifies the locations and release histories of contaminant sources under model and data uncertainties. Coupled with industry-standard flow and transport simulators MODFLOW and MT3D, CONSID© offers environmental managers a user-friendly interface to robustly estimate contaminant sources when available information is limited and uncertain.

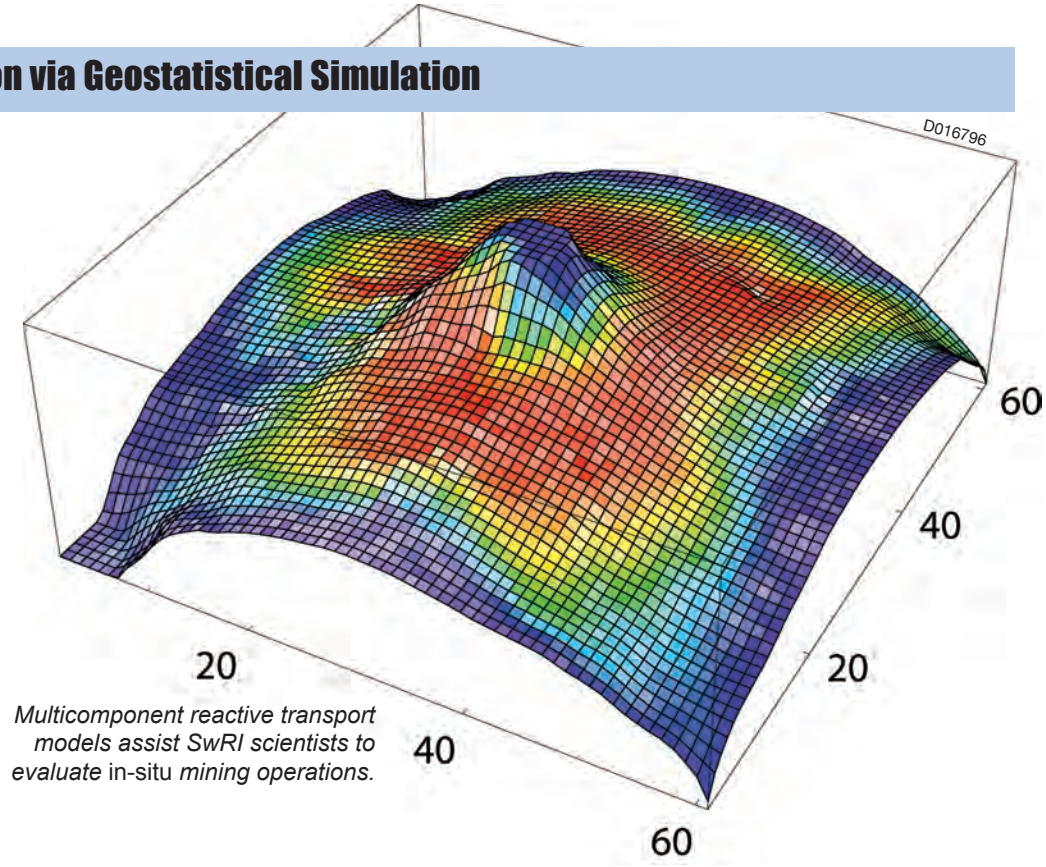


CONSID© software helps SwRI staff members evaluate release histories of contaminant sources while quantitatively accounting for model and data uncertainties.

Data Assimilation via Geostatistical Simulation

Geostatistical simulation can assess uncertainty associated with flow and transport in heterogeneous porous formations. SwRI capabilities include:

- ❏ Generating realizations of the subsurface properties conditioned on both static and dynamic data
- ❏ Conducting sequential parameter estimation using various ensemble Kalman filter algorithms



Multicomponent reactive transport models assist SwRI scientists to evaluate in-situ *mining operations.*

Field Investigations

SwRI has conducted extensive field studies worldwide integrating diverse capabilities to evaluate geologic and geochemical controls on groundwater flow and contaminant transport. Field expertise includes:

- ❏ Infiltration, permeability and moisture measurements
- ❏ Regional and site-scale geologic and topographic mapping
- ❏ Structural geologic characterization of hydrologic systems
- ❏ Surface and underground geologic mapping
- ❏ Rock, mineral, water, soil gas and vegetation sampling
- ❏ Contact gamma radiation mapping
- ❏ Transient electromagnetic soundings for perched water zones

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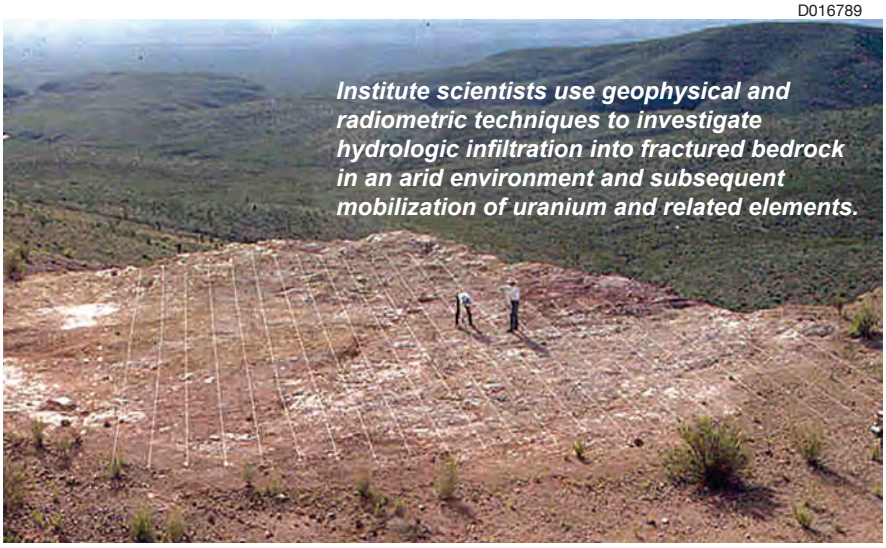

Institute scientists use geophysical and radiometric techniques to investigate hydrologic infiltration into fractured bedrock in an arid environment and subsequent mobilization of uranium and related elements.

- ❏ Resistivity surveys for aquifer characterization and karst feature delineation
- ❏ Magnetometer surveys to constrain subsurface geology
- ❏ Radon measurements
- ❏ Wireless-sensor-based measurement of karst aquifer conduits

Laboratory Facilities

SwRI's extensive state-of-the-art laboratories are equipped for:

- ❑ Rock sample preparation and physical testing
- ❑ Saturated and unsaturated flow property measurements
- ❑ Scale-model studies in environmentally controlled chambers
- ❑ Aqueous and solid-phase geochemical analyses, including natural and synthetic radioactive materials
- ❑ Microbiological studies

These facilities support understanding and solving problems in:

- ❑ Thermally driven moisture redistribution
- ❑ Mineral solubilities and ion exchange properties
- ❑ Mineral sorptive properties
- ❑ Radiochemistry
- ❑ Microbial viability and processes in earth materials

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SwRI-conducted laboratory experiments determine thermodynamic parameters, solubilities and sorption behaviors for numerous chemical and radiochemical species and substrates.

Regulatory Analyses

The Institute analyzes various international, federal and state regulations and prepares review methods and criteria to demonstrate or evaluate regulatory compliance. Regulatory experience includes working with:

- ❑ U.S. Environmental Protection Agency
- ❑ U.S. Mine Safety and Health Administration
- ❑ U.S. Nuclear Regulatory Commission
- ❑ U.S. Department of Energy
- ❑ U.K. Department of the Environment
- ❑ Swedish Radiation Protection Institute
- ❑ Swedish Nuclear Power Inspectorate
- ❑ Natural Resources Canada
- ❑ Organization for Economic Cooperation and Development, Nuclear Energy Agency
- ❑ International Atomic Energy Agency
- ❑ French Institute for Radiational Protection and Nuclear Safety

Southwest Research Institute, an independent, nonprofit applied engineering and physical sciences research and development organization with 11 technical divisions, uses multidisciplinary approaches to problem solving. The Institute occupies more than 1,200 acres in San Antonio, Texas, and provides more than 2 million square feet of laboratories, test facilities, workshops and offices for more than 3,300 employees who perform contract work for industry and government clients.

Benefiting government, industry and the public through innovative science and technology

We welcome your inquires.
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