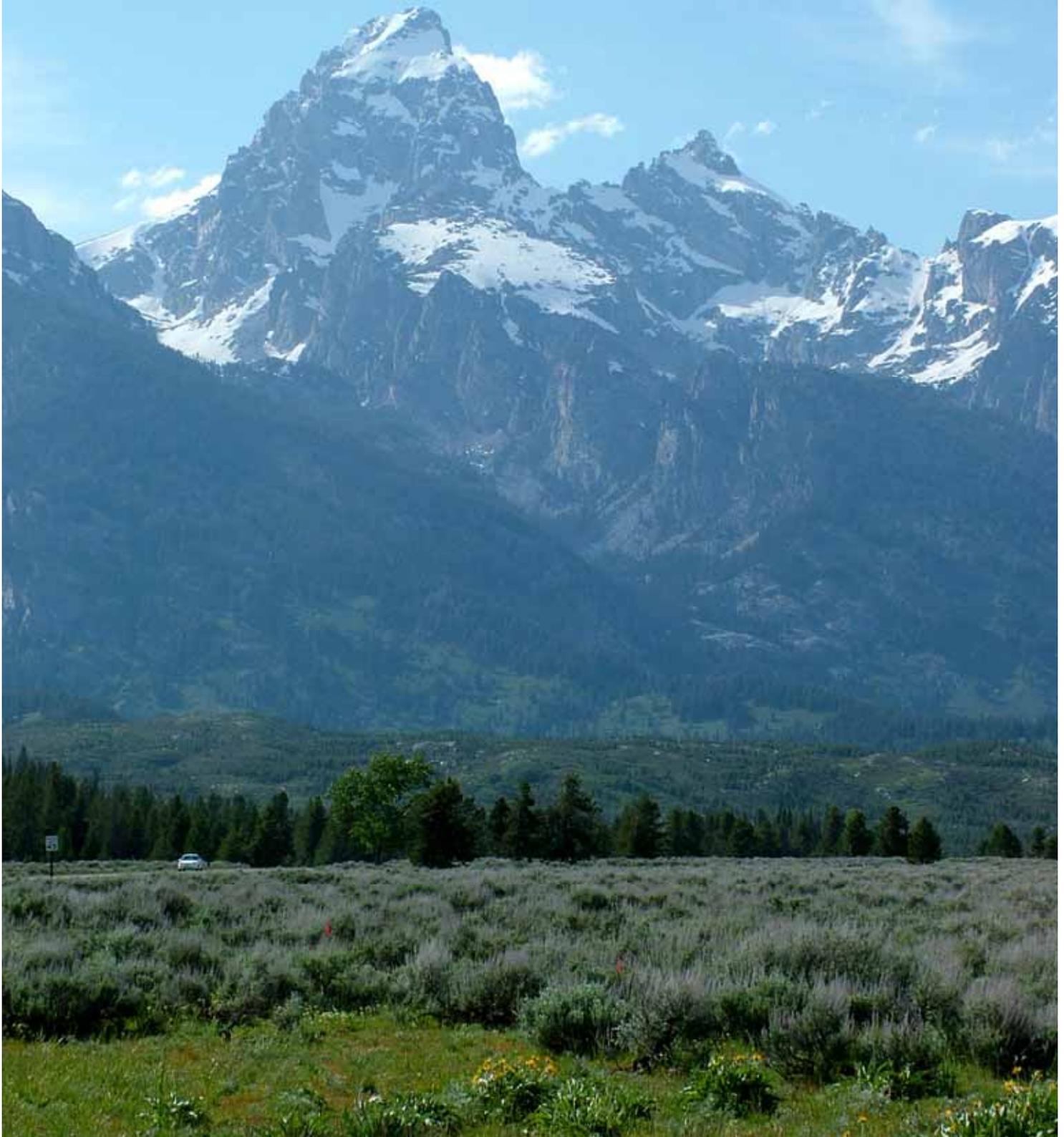


National Park Service
U.S. Department of the Interior

Geologic Resources Division
Denver, Colorado



2005 Geologic Resources Division Natural Resources Challenge Report





2005 Geologic Resources Division

Natural Resources Challenge Report

Geologic Resources Division
Denver, Colorado

U.S. Department of the Interior
Washington, D.C.



Mammoth Cave National Park, Kentucky

Executive Summary

This Geologic Resources Program provides support to parks and the Directorate on a broad range of geologic science and minerals management activities. It coordinates Servicewide functions and provides park managers with geoscience and regulatory expertise related to cave and karst systems, coastal and surficial geologic processes, disturbed land restoration, fossil resources, geologic hazards, soil resources management, environmental effects of mineral extraction, mineral extraction technology and engineering, and associated NPS policy and legal authorities to assist resource management decisions. Since its inception in 1995, the program has had limited travel and project support funding with base budget essentially limited to professional staff personnel costs. In 2000, the program received a Natural Resource Challenge increase of \$695,000 to add six geologic specialists. In 2005, through a reorganization of the Natural Resource Program Center, the Division gained the expertise of a soil scientist, one of only two in the NPS.

The Geologic Resources Division has 28 permanent staff engaged in six broad areas: Geologic Processes and Features, addressing geologic resource management concerns, research coordination, and public awareness; Disturbed Lands Restoration, assisting parks to remediate resource damage caused by previous human activities; Geologic Resource Evaluation, focused on geologic mapping and issue evaluation; Soil Resources Inventory and Management, addressing soil mapping, reports, and technical assistance; Minerals Management, assisting park to prevent and mitigate effects from mineral development in and adjacent to parks; and establishment of the National Cave and Karst Research Institute. Eight partner employees who work directly with NPS people augment division staffing. The Division also accomplishes many of its projects by utilizing partnerships with geologic organizations and leveraging funds from other NPS sources, such as Recreational Fee Demo and NRPP.

In FY 2005, the Division continued its efforts to enhance NPS understanding of geologic resource management concerns and to increase geoscience expertise in the Service. This is succeeding as the NPS geoscience staff, while still limited, has grown over 30% since 1995 to an estimated 100 positions across the Service in 2005. At least 10 of these new positions resulted directly from Challenge funding, and many parks have restructured other positions to address geology concerns.

Given the limited internal NPS geoscience capacity, assistance from the broader geologic community is important to supporting park resource management. The professional geoscience community has been responsive to NPS needs and, through the Geologic Resources Division staff, the NPS has been able to channel this interest to yield positive results for parks. Partner organizations, such as the American Geological Institute, Geologic Society of American, US Geological Survey, and State Geologic Agencies have facilitated geologic research, education and interpretation efforts and leveraged NPS funds for park resource management projects. For example, the programs Geoscientists-in-the-Parks partnerships have provided about \$4 million for volunteers and interns in recent years, outmatching NPS funds by over 4 to 1. These partnerships have led to improved park resource management and better information sharing by the NPS with the public.

Many of these partnerships are essential to the Division's progress in accomplishing geologic inventory efforts under both the Geologic Resource Program and the Soil Resources Inventory Program. The latter program relies heavily on its partnership with the Natural Resources Conservation Service in the U.S. Department of Agriculture.

The Geologic Resources Program directly assists NPS in meeting its Strategic Plan goals. Division staff serves as the Servicewide coordinators for the NPS Disturbed Land Restoration and Paleontology goals. The NPS Strategic Plan target for GPRA Goal Ia1A – Disturbed Lands Restoration was to restore 8,700 acres in parks by September 30, 2005, which was exceeded with parks reporting a total of 8,870 acres restored. The FY 2005 Strategic Plan target for Goal Ia9A - Paleontological Localities was to have 37% of known paleontological localities in parks in good condition, which the NPS met with parks reporting 1,199 of 3,250 localities in good condition. The Division also contributes to the NPS Natural Resource Inventory Goal Ib1 by completing park geologic mapping and soil inventories through the Geologic Resource Evaluation initiative and the Soil Resources Inventory.

Highlights of program accomplishment in FY 2005 include the following:

- The Geoscientists-in-the-Parks partnerships placed 51 geoscientists in 29 parks and 3 central offices to address needs in interpretation, resource management, and research. This resulted in NPS receiving geoscience expertise valued at over \$600,000 with direct Division costs of less than \$30,000. Partners included the Association for Women Geoscientists, American Geological Institute, Geological Society of America, museums, universities, and park associations.
- Disturbed land restoration staff managed Servicewide funding and oversaw 13 projects in 12 parks, which restored nearly 300 acres of severely disturbed land. Staff responded to over 30 park requests involving abandoned mine safety, disturbed land, geomorphologic issues, and geologic hazards, providing analysis, mitigation and restoration designs, cost estimates, and project oversight. Restoration projects included canals in Everglades NP, uranium mines in Canyonlands NP, gravel pits in Craters of the Moon NM, disturbed sites at Prince William Forest Park and Canyon De Chelly NM, coastal beach/dune landforms at Apostle Islands NS, mine hazards at Mississippi NRRA; and cinder pits at Lava Beds NM.
- Minerals management staff assisted 26 parks and 1 national historic landmark, providing extensive support to park managers in addressing the often contentious issues associated with private mineral development in and adjacent to parks. The expertise in mining and oil and gas technology, impact mitigation, regulations, and policy helped NPS managers to protect park resources from the adverse effects of past, current, and future mining and drilling.
- Using Recreation Fee Demonstration funds and working with partners, Division staff initiated development of a

geologic monitoring manual and website, addressing monitoring techniques for aeolian, caves and karst, coastal, fluvial, geothermal, glacial, hillslope (geohazards), lacustrine, marine, paleontology, permafrost, seismic activity, and volcanic resources. The Geological Society of America will publish the manual in the Fall of 2006. The NPS website will complement the manual with case studies and park-specific guidance.

- The soil scientist helped initiate a "Dynamic Soil Properties" project with the Natural Resources Conservation Service and the Northern Colorado Plateau Vital Signs Network at Arches and Canyonlands National Parks. The pilot project will evaluate soil properties prone to change over short periods from anthropogenic stressors, determine how to collect these properties in ongoing surveys, and how to store them in a database. A special project at Big Bend National Park will help park staff understand soil change and dynamic soil properties important to soil and vegetation restoration in their "Grasslands not Badlands" project.
- The Geologic Resource Evaluation team convened 28 scoping meetings with park staff and geologic experts from partner organizations to identify pressing park geologic resource management issues and park digital geologic mapping needs.
- Staff worked to strengthen the partnership with the U.S. Geological Survey (USGS) resulting in the bureau Directorates endorsing a series of initiatives to develop more effective links between the agencies proposal processes, facilitate joint project development, and support targeted USGS science in parks. Division staff joined the USGS National Cooperative Geologic Mapping Program's project review panel, which directs about \$2 million annually in USGS funding to geologic mapping in parks. Staff also helped plan the USGS "Understanding the Appalachians" interagency workshop that resulted in \$75,000 from USGS for mutually beneficial FY 06 science projects in the Appalachians.
- Division staff initiated a promising new partnership project between local geological societies and nearby parks in 2005. A pilot effort between the Rocky Mountain Association of Geologists and Great Sand Dunes NP is already providing useful education and resource management products for the park.
- With Division leadership, NPS was major presence at the Geological Society of America's Annual Meeting with over 140 technical presentations in 34 sessions having a park geology theme, ranging from field trip curriculum to park paleontology, geologic mapping, and geohazard management. Division staff chaired five sessions, organized two poster sessions, presented six talks, and staffed the popular NPS booth in the meeting's exhibit hall.
- Geohazard projects included assessment of a landslide and rock fall potential along a popular hiking trail in Bryce Canyon NP; evaluation of landslides from record precipitation at Santa Monica Mountains NRA and Cabrillo NM; evaluation of avalanche, landslide, debris flow and rock fall hazards at a backcountry campground in Klondike Gold Rush NHP; evaluation of potential rock fall hazards on road in Colorado NM; and assessment of flood and erosion hazards at Manzanar NHP, Canyon de Chelly NM and Delaware Water Gap N.R.A.
- The Division supported paleontological surveys at Black Canyon of the Gunnison NM and Curecanti NRA, which lead to the discovery and documentation of 37 paleontological localities in these parks, including the discovery of a new dinosaur site in the Morrison Formation at Curecanti NRA.

Geologic Resources Program Overview

The NPS established the Geologic Resources Division in 1995 as a component of the Natural Resources Program Center, which was created at that time to coordinate Servicewide resource management programs and provide specialized professional expertise to parks across the System. The Division was formed by redirecting and broadening the responsibilities of the prior Mining and Minerals Branch and adding two additional staff with geology expertise from other offices. No additional funding was available at that time for geologic work. In FY 2000 the Natural Resources Challenge provided \$695,000 in new funding for geologic resource management programs, which supports six new geoscience specialists in the division in the areas of cave and karst resource management, coastal geology, disturbed land restoration, geologic hazards management, and paleontology, complementing the expertise of existing division staff. That same year, the Division assumed responsibility for establishing the National Cave and Karst Research Institute. The Institute received its initial funding in FY 2001 through a separate Congressional authorization.

NPS advances in resource management because of the Natural Resource Challenge and the Geologic Resources Division have lead to an increase in geoscience expertise in the Service. In 1995, there were less than 70 geologists working in the Service. The 2005 estimate is now over 100 geology specialists working within NPS, with almost 60 in park- based positions. At least 10 of these new geology positions are a direct result of Challenge funding with the remaining positions created through the restructuring of non- geology positions. These specialists provide unique expertise to manage projects and to collaborate with non- NPS geoscience organizations. This additional expertise has facilitated the NPS understanding of its geologic resources and natural system interdependencies, resulting in improved park management decisions and the provision of better information to the public, as outlined below.

The geoscience community is committed to advancing science-based management and understanding of the geologic resources of the National Park System. Because NPS geology staffing remains limited, most of the geologic research, education and interpretation, and many resource management projects are done through or funded by external partners. Utilizing the external geoscience interest in parks, NPS staff have developed cooperative ventures that increase the geologic capabilities of the Service and create an awareness of NPS issues in the geoscience community. For example, partner funding has resulted in placing about 500 Geoscientists- in- the- Parks student volunteers and experienced professionals in parks in recent years. Presently, external support is limited only by the Service's ability to provide coordinating staff and matching funds to meet the community's offers.

The Division's functions and FY 2005 accomplishments are summarized below under the seven broad program areas: Geologic Processes and Features, Geologic Education and Outreach, Disturbed Lands Restoration, Geologic Resource Evaluation, Soil Resources Inventory and Management, Minerals Management, and the National Cave and Karst Research Institute. The Division accomplishes many of its projects by utilizing and leveraging funds from other NPS sources and partner organizations.

The across- the- board reductions In FY 2005 compounded the Division's existing base funding limitations. (The base increase noted above represents the correction of various Natural Resources accounts to reflect prior year travel reductions properly, not an actual increase.) This resulted in the Division relying on over \$73,000 in travel funding from other sources, including NRPP and other Natural Resources offices, to provide critical geologic resources management technical assistance and support services to parks. Of particular concern was the need for field offices to fund \$15,000 for Division staff travel to participation in field projects, burdening those parks needing geologic resources management services. Finally, numerous park requests for technical assistance were not undertaken due to travel constraints.

Geologic Processes and Features

Caves and Karst

The National Park System includes 121 parks known to contain important cave and karst resources. Over 3900 caves are within NPS managed lands, in parks ranging from Guam to Maine, and NPS treats all these as significant caves under the Federal Cave Resources Protection Act.

In 2005, the Division's cave and karst resource management staff provided technical assistance and support to cave



A Cave Salamander (*Eurycea lucifuga*) near the exit gate in Cudjo Cave, Cumberland Gap National Historic Park, Kentucky

stewardship efforts across the System. Park technical support highlights include: developing strategies for a cave management plan at Yosemite NP and conducting a cave management workshop for Yosemite and Sequoia- Kings Canyon staff with researchers from the Cave Research Foundation, the National Speleological Society, and the USGS; assessing the design of cave entry and exit doors in Cumberland Gap NHP; evaluating travertine depositional features and paleontology resources at Vicksburg NMP; evaluating cave resources and mines at Mississippi River NRA; assisting Wind Cave NP and Sequoia-Kings Canyon with cave diving issues; and working with Hawaii Volcanoes NP staff on controversial issues about cave entry, high carbon dioxide levels in caves, and NPS permitting procedures.

Cave management staff also worked with other offices on Servicewide issues and assisted with the continued development of the National Cave and Karst Research Institute in Carlsbad, New Mexico. This included projects such as participating in vital signs monitoring discussions on cave and karst issues for the Great Plains Network, convening a workshop with superintendents and resource management staffs from several primary cave and karst parks to discuss NPS concerns in the development of the National Cave and Karst Research Institute, working with the Concession Environmental Management Program and the Integrated Pest Management coordinator on an article on bats for the NPS concessionaire's newsletter GreenLine, and assisting the Bureau of Land Management's cave specialist with draft legislation to establish the first cave conservation area in New Mexico. Division staff also gave cave and karst management presentations at the Geologic Society of America Annual Conference.

Coastal Geology

The Division's coastal geology staff provides technical oversight and support and policy/regulatory advice to the almost 100 NPS units with coastal and lakeshore geology concerns. In 2005, staff worked closely with NPS Inventory and Monitoring Networks to define coastal resource monitoring plans and inventory needs. Following the numerous hurricanes this year, staff assisted parks with obtaining remotely sensed data, particularly LIDAR and airborne photography, and with storm response issues. Collaboration with the US Geological Survey continues to develop new protocols for coastal geologic mapping to integrate submerged marine resources with adjacent lands at Kaloko- Honokohau National Historic Park and Dry Tortugas National Park (see Geologic Resources Evaluation section). The "Vulnerability of Coastal Resources to Climate Change" project with the USGS, undertaken with NRPP and Recreational Fee Demonstration funds, resulted in the publication of assessments of vulnerability to sea- level rise at six parks.

Coastal geology staff initiated a Natural Resource Program Center "coastal team," with quarterly conference calls, to enhance communication and consistency across the Center's divisions and improve assistance to parks, regions, and the NPS Directorate. The staff also helped identify coastal issues for many Alaska parks and coordinated several coastal and marine mapping topics for the NPS Ocean Parks Task Force. Other specific accomplishments include debut of a teaching module for the web- based education center, supervision of coastal Geoscientist- in- the- Parks projects and research conducted by graduate and undergraduate students, oversight of the NRPP- funded boat wake study at Boston Harbor Islands National



Park staff repair the storm-damaged Kaloko fishpond wall at Kaloko-Honokohau National Historic Park, Hawaii

Recreation Area, and the provision of policy/regulatory assistance to coastal parks coping with dredging and disposal activities. At the close of an active weather year, Hurricane Katrina made landfall on the Mississippi units of Gulf Islands National Seashore and in Jean Lafitte National Historic Park and Preserve in August, forcefully demonstrating how coastal shoreline processes can affect people's daily lives and leaving permanent reminders that barrier islands are extremely dynamic, transient features. Division staff coordinated with other agencies and university scientists to provide coastal process expertise to park managers. The NPS post- hurricane response decision- making was greatly aided by the existence of baseline geologic information and remote sensing data.

Geohazards

In 2005, Division staff provided technical expertise in the assessment and evaluation of geohazards in numerous parks, in response to park requests. The control of naturally occurring geologic processes are challenging and generally expensive, often futile, and can have harmful impacts that can outweigh their benefits if not well planned. To reduce the hazard, the staff provided assistance by acquiring scientific information about the nature of a park's geologic hazards and the degree of risk they represent, then incorporating that information into the planning process and providing recommendations for park management decisions to help minimize the exposure of people and facilities to hazards. Examples of technical support for the



Rockfall hazards above Wall Street on Navajo Loop Trail, Bryce Canyon National Park, Utah

year included the assessment of a recent landslide and rock fall potential along a popular hiking trail at Bryce Canyon NP, the evaluation of several landslides resulting from record precipitation at Santa Monica Mountains NRA and Cabrillo NM, evaluation of avalanche, landslide, debris flow and rock fall hazards to the relocation of a backcountry campground at Klondike Gold Rush NHP, the evaluation of potential rock fall hazards to roadways at Colorado NM, the assessment of flooding and erosion hazards at Manzanar NHP, Canyon de Chelly NM and Delaware Water Gap N.R.A. and the coordination of a workshop to improve park interpretive staff understanding of the geohazards and effective techniques at communicating this information to park visitors at Golden Gate NRA, Point Reyes NS and Rocky Mountain NP. (GPRA goals Ia1A, Ia2, IIb1)

Because the NPS is not alone in the need for comprehensive hazard assessment, monitoring, and planning, Division staff participated in multi- agency workshops to develop nationwide mitigation strategies for geohazards. Federal land management agencies such as the Bureau of Land Management, the US Forest Service, many municipalities, and most states must address geohazards. In 2005, staff worked with the Ohio Department of Natural Resources in the evaluation of a large landslide along the Little Beaver Creek NSR. Other partnerships included contacting the USGS for assistance with rockfall hazard issues at Devils Tower NM and coordinating responses with the USFS on geohazard related issues.

Paleontology

Diverse fossil resources have been documented in 179 parks and include plants ranging from microscopic algae and pollen to leaves and petrified logs, and animals ranging from marine shells to dinosaurs to Ice Age mammals, as well as trace fossils such as vertebrate tracks, burrows and coprolites. Many of these natural resources in parks are of international significance and critical to understanding the history of life on Earth. The Natural Resource Challenge provided funding FY 2000 to support a Division paleontologist to develop a Servicewide program to manage fossil resources in the NPS, and to provide technical assistance to parks. In FY 2005, the incumbent vacated the position and the Division was unable to rehire due to funding constraints, resulting from increasing personnel costs and across- the- board budget reductions. However, other Division staff assumed many duties to of the paleontology coordinator to address critical issues.

Division staff serves as the Servicewide coordinator for GPRA Goal Ia9: Paleontological Localities and during FY 2005 worked extensively with regional coordinators and park staff to ensure NPS consistency in implementation, performance planning and reporting of results. As a result, the Service met the FY 2005 Goal Ia9 target of 37% of paleontological localities (in- situ fossil sites) in parks in good condition. Parks reported 1,199 of the 3,250 baseline localities in good condition, meaning that human activity is not affecting the fossil resources, sufficient information is available for resource management, appropriate actions are taken to preserve information, and the locality provides opportunities for scientific research. Staff also coordinated NPS quarterly reporting of locality data and program accomplishments to the Department of the Interior through Required Supplementary Stewardship Information (RSSI) "natural heritage asset" reports and responded to several audit requests for information pertaining to RSSI reports.

In 2005, the Division supported paleontological resource surveys at Black Canyon of the Gunnison NM and Curecanti NRA, utilizing Recreation Fee Demonstration funds. This field work led to the discovery and documentation of 37 paleontological localities in these parks. Fossil resources included invertebrate and large vertebrate burrows, dinosaur bones, plant material, shell molds, fish gill rakers, fins and scales. Most notably, the field survey led to the discovery of a new dinosaur site in the Morrison Formation at Curecanti NRA. Division funding also supported a report entitled "Arches National Park Paleontological Survey," which includes a description of the park's geologic history and stratigraphy, fossil resources and localities, and resource management, interpretation, collections management and research recommendations.



Museum of Western Colorado paleontologist and NPS paleontological technician locating, document, and collect hundreds of dinosaur bones from a newly discovered locality that is threatened by human and natural impacts in Curecanti National Recreation Area, Colorado

Geologic Education and Outreach

The Division continues to promote "Conservation through Cooperation, Consultation and Communication" with undertakings designed to increase public awareness of the unique geologic resources in parks and to engage the professional geology community and earth science educators in using parks for teaching and research. The NPS geology website is an important component of the public outreach effort. The Division maintained site highlights geologic program areas and has content ranging from visitor geology tours to scientific knowledge of park and regional geology. The website has numerous useful links to geologic community websites, such as the National Science Foundation's Digital



GRD staff discuss NPS geologic resources with attendees of the Geological Society of America's (GSA) Annual Meeting in Salt Lake City, Utah



Park staff attendees of Oregon State University's interpretive training program in Rocky Mountain National Park, Colorado

Earth Science Library and EarthScope pages, and U.S. Geological Survey and state geological surveys sites. The NPS geology website is dynamic, has very high visitation, and receives frequent inquiries and positive reviews from the public.

The Division was a noteworthy player in two major outreach events in 2005, the Geological Society of America's (GSA) Annual Meeting and the George Wright Society (GWS) Biennial Conference. Park geology has become a significant topic at the GSA meeting, with over 140 presentations in 34 different sessions having a park- related theme, with topics ranging from geologic field trip curriculum to scientific discussions on park paleontology, geologic mapping, and geohazard management. Division staff chaired five sessions, presented six talks, organized two poster sessions, and staffed the increasingly popular NPS booth in the meeting's exhibit hall. Staff also made contributions at the GWS meeting by distributing of NPS geology- related materials, running meetings, and chairing a session entitled "Ecosystem Management Concepts: Connecting the Dots Between the Physical and Biological Sciences."

Cooperative education projects initiated in 2005 included using Recreational Fee Demonstration funds to work with Oregon State University's geology department to provide geology interpretive training to 75 park staff members at Arches, Canyonlands, Golden Gate, Point Reyes, and Rocky Mountain NP. Additionally, the division supported scholarships for four park staff to participate in an on- line college level geology training through Oregon State University. Working with the American Geological Institute, staff provided earth science education packets to all NPS units in support of Earth Science Week. The Geoscientists- in- the- Parks program also accomplishes education goals through partner- leveraged resources. Staff helps earth science teachers utilize national park examples for understanding the concepts and processes of geology.

Partnerships activities with the geologic community continued to be a major effort for the division in 2005. Division staff coordinate with the broad- based geologic organizations including the American Geological Institute (AGI), American Geophysical Union (AGU), Geological Society of America

(GSA), Association of Women Geoscientists, National Park Foundation (NPF), and the National Association of Geoscience Teachers (NAGT), as well as numerous specialized geology organizations such as the Cave Research Foundation, National Speleological Society (NSS), and Society of Vertebrate Paleontology (SVP). For example, the AGI is helping the NPS develop a geologic poster series and a brochure on the geology of the National Park Service. One of the most promising new partnership efforts initiated in 2005 is between local geological societies and parks, which began with a pilot effort between the Rocky Mountain Association of Geologists (RMAG) and Great Sand Dunes NP. The local geologic expertise from the RMAG members is already providing useful education and resource management products for the park.

Staff continued efforts in 2005 to facilitate geoscience research by working with the scientific community to meet parks' research needs. They connected Geoscientist specialists with park staff to help examine research proposals and conduct peer reviews, and to identify significant research needs that would facilitate understanding and management of the park resources. The division continued to work with EarthScope project staff to facilitate the placement of research equipment in national parks and providing outreach to the public. EarthScope, the largest earth science project ever funded by the National Science Foundation, is examining how plate tectonics continue to shape our country. Staff also worked on with Memphis State using a new 3- D laser scanning technology to investigate effects of rock climbing on lichen species on rock outcrops at Shenandoah National Park. Initial study results are promising and the technology may have additional applications for park resource management.



Members of the Association of Women Geoscientists accompany NPS staff on the Permian reef trail in Guadalupe Mountains National Park, Texas

Geoscientists-in-the-Parks

Division staff manages the Geoscientists- in- the- Parks (GIP) partnerships, working with professional geologic organizations and the academic community to meet the large backlog of NPS geoscience needs in parks. The GIP endeavor made significant strides in FY 2005 by:

- placing 51 geoscientist participants in 29 parks and 3 central offices, and working to ensure opportunities were open to diverse candidates;
- receiving most assistance through volunteer experts and students, and other assistance at greatly reduced costs;
- realizing direct and in-kind partnership matches to NPS funds at a more than a 4:1 ratio;
- gaining more than \$607,000 worth of expertise with less than \$30,000 in program funds;
- reaching an estimated 100,000 visitors with geologic outreach and education programs, and hundreds of thousands through website visits;
- facilitating transfer of geologic information to more than 740 park staff ;
- accomplishing a large variety of geoscience projects focused on managing park resources that helped parks address numerous GPRA and NPS Legacy goals.

GIP participants were able to complete more than 75 projects in 2005 and help parks meet critical needs in natural resource management, research, public safety, and both formal and informal education. The GIP success is an outstanding example of meeting the Service's many needs through cooperative partnerships and collaboration. Over the 10 years of it's



Stephanie Shepard spent 12 weeks at Sunset Crater National Monument, Arizona evaluating the development of volcanic soils and helping park visitors understand volcanology. Her position was made possible through a partnership with the Geological Society of America's GeoCorps Program.



Geologist Callan Bently, of George Mason University, served as a GIP participant, at the request of the Urban Ecology Research and Learning Alliance. Bently translated key points of technical geologic research into summaries for use by managers, park guides, and the public.

existence, GIP participants have helped parks address more than 25 Strategic Plan goals, ranging from goal Ia- Land Health: Coastal, Disturbed Lands, and Riparian to goal Ib- Inventory/ Museum Collections to goal IIa&b- Visitor Satisfaction/ Understanding and goal IVb - Park Partnerships.

Examples of GIP projects and the collaboration that made them a reality in FY 2005 include:

- At Knife River Indian Village and Fort Union Trading Post NHS, a professional geomorphologist examined rapid erosion and potential mitigation to address riparian land health concerns (GPRA Ia1D). This international participant was placed in collaboration with the Association for Women Geoscientists, Student Conservation Association, and the NPS International Affairs office, and the GIP worked closely with the NPS, Bureau of Land Management, U. S. Army Corps of Engineers, and USGS staff.
- At Glacier National Park, a GIP participant completed a paleontological overview report and provided a seminar for park managers to help them understand the significance of the park's paleontological resources, applications in park planning, and information for visitors (GPRA goals Ia9, Ib2D, IIb1). This placement was a collaborative effort with the Geological Society of America and the park's Crown of the Continent Research Learning Center.
- At Padre Island NS, a GIP completed a 3- year coastal geomorphology project compiling a synthesis of existing research results, revising geomorphic maps, and examining geomorphic risks to structures and visitors (GPRA goals Ia1F, Ib1, IIa2). The project will help park managers address resource concerns, and protection of structures and public safety. This partnership involved NPS, Baylor University (TX), and the U.S. Army Corps of Engineers.
- At Canyonlands NP, a GIP graduate student at the University of Colorado completed an up beat and scientifically accurate geologic processes animation and "fly- through" for use in the park's new visitor center film (GPRA goals IIaA, IIb1, IVb2).



Barton Bronson created a database and cataloged over 10,000 vertebrate fossils for Petrified Forest National Park, Arizona. Bronson's position was made possible through a partnership with the Geological Society of America's GeoCorps Program.

- At Grand Canyon NP, a GIP documented the successes of NSF-funded project exploring the park's geologic history and researching the formation of the canyon and the scientific theory of Snowball Earth. The volunteer videotaped interviews and captured digital images for presentations in the new Yavapai visitor center, as well as to schools and Web visitors in a virtual Views tour of the park's geology (GPRA goals IIa1A, IIb1, IVb2). This was in collaboration with the park, several universities, and the Natural Resource Information office.

Disturbed Land Restoration/Abandoned Mineral Lands Reclamation

The Natural Resource Challenge provided funding in FY 2000 to hire two geomorphology specialists who, added to the disturbed lands program coordinator and mine safety and reclamation specialists, greatly enhance the capabilities of the Division to provide assistance to parks regarding disturbed lands and surficial geologic issues. The Challenge also established the Disturbed Lands Restoration fund (\$850,000) within the NRPP program, managed by Division restoration staff. The Division provides three primary functions related to restoration and geomorphological issues: park project funding, technical assistance, and Servicewide coordination.

The Disturbed Lands Restoration program allocates NRPP project funds to parks based on competitive proposals. Division staff prepares the technical guidance, reviews park work plans for technical adequacy, and provides oversight on cost accounting and accomplishments reporting. In 2005, disturbed land restoration program staff oversaw \$808,000 in NRPP restoration project funding for 13 projects in 12 parks, representing five NPS regions. These projects restored nearly 300 acres of severely disturbed land. Examples include

restoration of natural cave drainage in Timpanogos NM, reclamation of the placer-mined Glacier Creek in Denali NP, restoration of a segment of the Merced River by removing the Happy Isles Dam in Yosemite NP, and restoring the hydrology and soil disturbances associated with illegal marijuana plantations in Sequoia/Kings Canyon NP.

Division restoration and reclamation specialists responded to over 25 technical assistance requests in 2005 involving disturbed lands, abandoned mine safety, and geomorphological concerns. Staff provide key technical assistance to park restoration efforts through site assessments, safety hazards analysis and mitigation design, geomorphic analyses and landform restoration design, materials/equipment cost estimates, and project oversight assistance. Many of these efforts will lead to park proposals for project funding to implement the recommended actions. Examples of park technical support in 2005 include: development of restoration alternatives for canals on Cape Sable, Everglades NP; uranium mine site characterization in cooperation with USEPA, Canyonlands NP; restoration planning for gravel pits, Craters of the Moon NM; development of reclamation alternatives for a former landfill, mine site and stream channel, Prince William Forest Park; evaluation of stream disturbances and disturbed site inventory, Canyon De Chelly NM; planning for landform restoration of a coastal beach/dune landform complex at Apostle Islands NS; mine hazards inspection and recommendations, Mississippi NRRRA; and cinder pit reclamation design, Lava Beds NM.

Division staff serves as Servicewide coordinator for GPRA goals IaiA - Disturbed Lands Restoration and the new associated goal IaiG - land health, mined areas. For IaiA, the NPS Strategic Plan goal target was to restore 8,700 acres in parks by September 30, 2005. The NPS exceeded the goal target in FY 2005 with parks reporting a cumulative total of 8,870 acres restored. For the current NPS Strategic Plan, staff coordinated updates and review of the Technical Guidance, revising goal targets, and establishing new goal attributes.

Division staff also coordinated the NPS Cooperative Conservation Initiative (CCI) solicitation and worked closely with Department officials on the project approval and follow-up process for park submitted projects in FY 2004. For FY 2005, as requested by Department officials, staff solicited CCI



Construction of cedar revetment for bank stabilization at Cash Bend, Buffalo National River, Arkansas, one of ongoing FY05 NRPP disturbed lands funded projects.



Site assessment of abandoned mine hazards at Mississippi National River and Recreational Area, Minnesota

proposals from parks and selected 188 projects for submittal to the Department. Proposed contributions from 339 partners in these projects were almost \$11 million. However, Congress did not provide funds to the NPS for the CCI program in FY 2005.

Geologic Resource Evaluation

This Division- managed Geologic Resource Evaluation (GRE) is funded by the Inventory and Monitoring Program under the Natural Resource Challenge. The GRE helps park managers integrate the use of geologic resource information in resource management decisions. Division activities directly contribute to the achievement of NPS GPRA goal 1b1 natural resource inventories. Because this is a major activity carried out by Division staff, a summary of 2005 accomplishments is reported here. A more detailed update on the status of this project is contained in the Inventory and Monitoring Program report. The GRE provides parks with four main products: an onsite scoping meeting with park staff and geologic experts to evaluate and discuss the park's geologic resources and related resource management issues, along with investigating existing geologic research and paper maps; a comprehensive digital geologic map; a bibliography of geologic literature and maps; and a comprehensive geologic report.

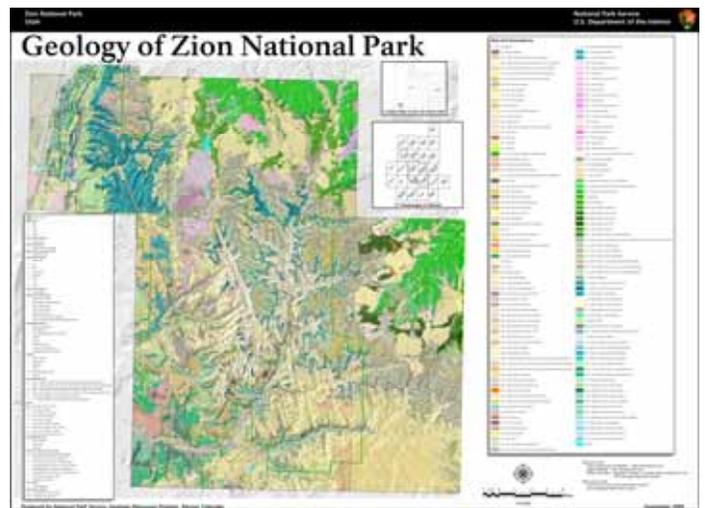
At the close of FY 2005, scoping meetings to evaluate park geologic resources and issues had been held at 154 parks in 31 states, 4 territories, and the District of Columbia. In addition to GRE staff, park resource managers and geologic experts from the USGS, state surveys, and universities participate in these meetings. Summaries of the meetings are posted on the NPS website. For 2006, 25 additional parks are slated for scoping meetings.

Producing a completed digitized map for a typical park entails converting map data from multiple textual maps, a time intensive and involved process. The entire digital conversion process is a highly complex GIS procedure. Our cooperators at Colorado State University are largely responsible for the generation of the data model used for this conversion. Their efforts remain at the forefront of the science and generate GIS products arguably among the most advanced produced by the NPS.

To enhance the user- friendliness of the digitized maps, extensive pull down help files are incorporated into the maps. Of the 272 parks characterized as "natural area parks" by the NPS Inventory and Monitoring Program, GRE staff and partners have completed digital geologic maps for 68 parks, which are served on the NR- GIS DataStore. Maps for an additional 10 parks are in various stages of conversion to a digital format and another 21 new parks are projected for 2006. Geologic bibliographies have been completed for all 272 natural area parks. A concerted effort to migrate over 50,000 references captured under the former "GRBIB" database to the Servicewide NatureBib bibliographic database is underway along with ongoing efforts to keep the database up to date.

In 2005, eleven new geologic reports, addressing geologic resource management issues, were distributed to their respective parks, networks, and regions. At the end of the year 41 other reports were in various stages of preparation, editing, or review and conversion to the NPS Messaging Format prior to distribution to the parks. Twenty- five of these are projected for completion in 2006. Additionally, geologic reports for the 13 New Mexico parks are being prepared through a partnership with the New Mexico Geologic Survey, the first volume of which is due for publication in 2006. The reports have proven quite popular with several parks making follow up requests for additional copies.

The lynchpin of the GRE remains extensive collaboration with partners. As mentioned above, scoping meetings routinely include participation with other federal, state, or academic geologists. Where gaps in existing geologic map coverage are identified, the Division will team or cost share with one of these scientists to produce a new map. In 2005, we partnered with the USGS for mapping in parks in Alaska, California, Arkansas, Missouri, and Texas; with state surveys for mapping in parks in Texas and South Carolina; and with universities for work in Arizona and Nevada. Additionally, we provided funding for fieldwork by NPS geologists for new mapping in Big Bend, Mt. Rainer, North Cascades National Parks and John Day Fossil Bed National Monument.



Derivative Map of the Geology of Zion National Park, Utah



During GRE scoping at George Washington Birthplace National Monument, Virginia, NPS and USGS geologists examine wave cut erosion caused by Hurricane Isabelle.

Since the advent of the program, new mapping projects by these partners have been initiated in over 45 parks. GRE support has become a critical selection factor for USGS, state, and academic geologists proposing mapping projects funded by the USGS National Cooperative Geologic Mapping Program (NCGMP); so critical, in fact, that in 2005 the NCGMP identified collaborative work with the NPS as one of their OMB PART goals. Later in the year, the two agencies agreed to share map databases, which will provide enhanced access for the GRE to the USGS map database and direct access to GRE generated maps for the USGS site.

As in previous years, the GRE continues to support shoreline and marine geologic mapping and the products and benefits are starting to appear. Preliminary landform maps for barrier island parks in North Carolina, Florida, and Texas have been received and reviewed within the Division and by external experts. Preliminary marine benthic habitat maps, made in partnership with the USGS Coastal and Marine Program, have been produced for parks in Florida, the Virgin Island, and Hawaii. These draft products have already been used by park managers; at Canaveral and Cape Hatteras National Seashores to assess storm related damage and at Kaloko Honokohau National Historic Park and barrier island environments at Cape Hatteras National Seashore for use in new Coastal Watershed Assessments.

Sample applications of GRE products include:

- Ozark and Buffalo National Scenic Rivers - GRE funded maps are a significant tool for resource management at these two waterways. In addition to providing the framework to understand groundwater flow, entire karst ecosystems have been identified using the information contained in the bedrock geologic maps.
- Geologic Hazards at Yellowstone and Yosemite National Parks - While still in the digitizing stage, both of these heavily visited parks rely on their geologic maps for information on rockfall, flooding, geysers and hot springs, and the stability and safety of park infrastructure.
- Species Habitat Delineation at Coronado National Memorial - Park staff use a USGS geologic map produced with GRE support to inventory the odd and rare barking frog, whose habitat is closely tied to limestone outcrops. By using the map

to determine limestone distribution, park staff has been able to focus their efforts to determine the occurrence of the frog in the park.

- General Management Tool and Derivative Map at Zion National Park - Working together, park and GRE staff produced a derivative geologic map by draping the GRE geology over a shaded- relief topographic map. The resulting product graphically displays the park's geology and areas where specific, management concerns such rock fall and flooding, may be an issue.
- Using GRE Scoping for Other I&M Tasks - Scoping sessions, while intended to determine geologic map coverage and status, additionally benefit other I&M programs. At the Upper Columbia Basin, Klamath, and Southwest Alaska networks, discussions on geologic features and processes were integrated into Vital Signs and were used as a basis for network planning.

Soil Resources Inventory and Management

In 2005, the Division assumed responsibility for the Soil Resources Inventory and Management (SRI) program as part of a reorganization of the Natural Resource Program Center. SRI is one of the 12 inventories funded by the Inventory and Monitoring Program under the Natural Resource Challenge. It operates extensively through a partnership with the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) and the National Cooperative Soil Survey to undertake soil surveys in parks.

Managing parks to preserve fundamental resources, processes, systems and values depends on sound soil resource management. The natural features and diverse plant and animal communities depend on maintaining soil functions that support plant growth and limit accelerated soil erosion. Detailed information about the physical, chemical, and biological properties of soils in parks is essential for park resource management and protection, as well as providing park managers with the ability to predict the behavior of a soil under alternative uses.

Through the partnership with the NRCS, the SRI projects help parks secure the information needed to manage soil sustainability and to protect water quality, wetlands, vegetation communities, and wildlife habitats. The information also assists control exotic species and establishment of native communities, as well as more management of potentially high-



Performing Soil Aggregate Stability test at Big Bend National Park, Texas

use or developed areas in the park (e.g., visitor centers, campgrounds, trails, access roads). This directly contributes to the achievement of NPS GPRA goal 1b1 (natural resource inventories).

The key SRI products are digital maps of the park soils; data about the physical, chemical, and biological properties of those soils; information on the use and management of these soils; metadata; and information products such as a soil survey manuscript, fact sheets, and image galleries. The information is in sufficient detail for application by park managers, planners, engineers, scientists, and researchers to specific areas of concern. Although these soil resource inventories follow procedures identified by the National Cooperative Soil Survey, the specific work plans are customized by local park personnel to meet their soil resource management needs, as part of local soils scoping sessions.



Sharon Franklet, Botanist, investigating a soil profile at Pinnacles National Monument, California

As of the end of FY05, 70 NPS units have a completed SRI, with an additional 46 parks underway. Soil scoping sessions were initiated for six parks, and technical assistance was provided to an additional four parks on the use of the completed soil resource inventories for a wide variety of soil resource management issues.

The SRI for Gateway National Recreation Area illustrates how this program helps to advance the achievement of GPRA Goal 1b1. This comprehensive project, completed in 2005, investigated and documented native, anthropogenic, and subaqueous soils. NRCS mapped area soils at a detailed scale of 1:4,800 and generated comprehensive descriptions of soil types depicted on the maps. As an aid to understanding the unique anthropogenic aspects of the soil information, the detailed soil map integrated previous landfill and land use history information. A special mapping project of the subaqueous soils in the tidal marshes was undertaken to support the Jamaica Bay eelgrass restoration efforts. In addition to the soil map, park managers received a detailed soil survey report which contains special soil interpretations for urban, recreation, as well as ecological applications, and baseline soil data. The park will use the inventory to assist land use decision-making, including restoration, and for informational and educational purposes.

There are many challenges in completing a soil resource inventory on parklands, and most of our larger parks lack soil

maps. Working cooperatively with the NRCS and several universities, the SRI is pursuing the use of new soil mapping technologies to facilitate data acquisition in remote areas, as well as those parks where wilderness designation or the presence of cultural landscapes preclude the use of traditional methods.

Minerals Management

A longstanding major responsibility of the Division is to provide park managers, including the Director's Office, with minerals management expertise. Through a cadre of staff with expertise in mining and oil and gas development technology, regulations, policy, impact mitigation, geology, reclamation, and mining claim validity examinations, the Division helps park managers effectively protect park resources and values from the adverse effects of past, current and future mining inside and adjacent to units of the National Park System. Division assistance in the minerals management arena substantively contributes to the accomplishment of NPS Strategic Goal 1a related to the protection of natural and cultural resources in parks.

Currently, twenty-five NPS units contain nearly 750 active private mineral exploration or development operations, most involving the production of oil and gas. Private entities that hold property rights to oil and gas, and other minerals located inside parks must submit and obtain NPS approval of development plans and performance bonds before initiating mineral related activities. In 2005, the Division assisted park resource managers by reviewing 11 new oil and gas proposals covering 20 operations in four parks to ensure that the operations conform to NPS nonfederal oil and gas regulations. These regulations require operators to use technologically feasible methods least damaging to park resources. Division staff also helped oversee the plugging of two abandoned wells in parks, which often presents opportunities to work with partner organizations.

Division staff continued to track mining claim issues in parks and evaluated the implications of changes to the Mining Law of 1872. Staff also continued to represent the Service on the Department's Mineral Examiner Certification Panel. This BLM led panel develops nationwide guidance on implementing the Mining Law of 1872 and determines qualification of individual federal employees to undertake validity examinations. A validity examination is a process by which the federal government determines if holders of mining claims possess bona fide property rights. While all units of the National Park System are closed to the location of new mining claims under the Mining Law of 1872, 1292 mining claims exist in 18 parks. These claims pre-date the creation of the park units. The majority of the claims are located in Mojave National Preserve (CA), and Wrangell-St. Elias National Park and Preserve (AK).

On lands adjacent to parks, the NPS works with other federal and state permitting agencies, along with mining project proponents, to have park protection measures incorporated in mineral leasing or other energy development decisions. In 2005, Division staff assisted park and regional offices as well as other federal and state agencies on a variety of projects, such as TVA's draft EIS for the Koppers Coal Reserve adjacent to Big South Fork National River and Recreation Area, the State of Alaska's proposal to allow exploration on lands adjacent to Denali National Park and Preserve, the implications of the



Poorly maintained production site at Big South Fork National River and Recreation Area, Tennessee. Note the contaminated soils adjacent to the pumpjack and the secondary containment pit downslope from the site.

legislative change to the Gulf Island Enabling Statute that would enhance of the development of state oil and gas rights, and a prospective operator's interest in developing oil and gas immediately adjacent to the boundary of Theodore Roosevelt National Park.

In an effort to work more efficiently and cooperatively with other federal land management and permitting agencies, the Division represents the NPS on the Federal Energy Resources Network (FERN). Initiated in 2001, the FERN workgroup is comprised of representatives from the NPS, Bureau of Land Management, U. S. Forest Service, U.S. Army Corps of Engineers, Minerals Management Service, U.S. Fish and Wildlife Service, Environmental Protection Agency, and the Department of Energy. The goal of this group is to improve communication and efficiencies among federal agencies that have a role in planning, permitting, regulating and oversight of energy development in the United States.

Abandoned mining, and oil and gas exploration and production sites represent a substantial portion of the disturbed lands requiring restoration in parks. The NPS currently has as estimated 3,200 abandoned mineral sites with over 10,000 hazardous openings, at least thirty miles of streams with degraded water quality, and more than 33,000 acres of disturbed land. In FY 2005, the Division continued to assist parks address this outstanding reclamation need and augmented its efforts through partnerships.

Examples of the Division's efforts that advance NPS Strategic Goal Ia include:

- Division staff worked with Big South Fork National River and Recreation Area to plug a leaking gas located near a popular horse trail and scenic overlook. Division assistance to the park included providing justification in funding requests, developing plugging specifications for contract bidding, and providing onsite oversight to ensure the well was plugged properly. Past drilling in the park by now defunct companies has left a legacy of dozens of orphaned oil and gas wells. To address some of these problems, the Division helped the park secure future funding to plug eight more problem wells.
- For a proposed exploration well on a federal lease at Glen Canyon National Recreation Area, Division staff provided

policy, regulatory, petroleum engineering and geologic expertise as members of an internal NPS team working on evaluating this project. A key focus of the Division's assistance continues to be on identifying opportunities to minimize impacts on park resources and visitor values.

- In Big South Fork National River and Recreation Area and Obed Wild and Scenic River, the Division played a key role in the initiation of an Oil and Gas Management Plan for these parks. Working with park staff and the Environmental Quality Division, the Division provided key strategies to improve the efficiencies and effectiveness of the approach being taken with respect to the plan to assure it addresses the unique oil and gas management challenges facing these two parks.
- Division staff provided extensive assistance to the DOI Solicitor's Office in responding to litigation over a provision in the Service's nonfederal oil and gas regulations that encourages operators to access their in- park oil and gas rights from locations outside park boundaries. In an initial ruling in the case, the Federal Judge upheld the NPS interpretation of its regulation.
- At Nicodemus National Historic Site, Division staff aided the superintendent in evaluating the implications of potential oil and gas development in and adjacent to the historic site.



Clean and well maintained production operation in Big Thicket National Preserve, Texas. Note that the production area is fenced and free of debris.

National Cave and Karst Research Institute

A 1998 Act of Congress directed the NPS to establish the National Cave and Karst Research Institute (NCKRI) in the vicinity of Carlsbad, New Mexico. Provisions in the Act included joint administration by the NPS and an administrative partner, and that the expenditure of federal funds be matched by an equal amount of non- Federal funds. The NPS assigned the Geologic Resources Division the lead responsibility for establishing NCKRI in 2000. Congress provided an initial NPS operating appropriation in FY 2001, which lead to the Division's hiring of a permanent director duty- stationed in Carlsbad, NM. In FY 2003, Congress appropriated Federal construction funds totaling almost \$2 million for a NCKRI building. The State of New Mexico provided the matching non- Federal operating funds in 2001 and building funds in 2003. The unique legislation mandating NCKRI as presented unusual challenges for the NPS and potential partner organizations in our efforts to structure and formally establish the Institute as a fully operating entity.

Building a Karst Consortium

In 2005, NCKRI successfully extended its network of partners through a variety of efforts. Highlights included two separate NCKRI workshops that brought together members of the cave and karst community. First, superintendents and resource management specialists from eight National Parks with cave and karst programs met in May to review the Institute's progress and plans. The meeting also provided an opportunity for park managers to express their needs and discuss how NCKRI might help address them. Two weeks later our primary academic partner, New Mexico Institute of Mining and Technology (NMT), brought together representatives from thirteen governmental, academic, and private cave and karst programs on their campus for a two- day meeting. This meeting resulted in the establishment of an Interim Board of Directors, Executive Committee, and Board committees charged with formally establishing NCKRI, Inc., as a non- profit corporation. In November, NMT filed Articles of Incorporation with the State of New Mexico, moving NCKRI closer to achieving its mandate to become a jointly administered educational and research center.

In late- 2005, the institute's first national lecture tour provided informative and delightful lectures to cave and karst programs in Tucson, Arizona; Socorro and Carlsbad, New Mexico; San Antonio, Austin, and College Station, Texas; the Ozarks; Mammoth Cave and Bowling Green region, Kentucky; Blacksburg area, Virginia; Harpers Ferry, WV; and Schoharie, New York, as Dr. Elery Hamilton- Smith of Charles Sturt University, Australia, served as a NCKRI Visiting Distinguished Scholar. The tour was co- sponsored by the Northeastern Cave Conservancy (New York) and mostly organized by Patricia Seiser, a NCKRI volunteer.

International interest in NCKRI was also enhanced this year by four paper presentations by NCKRI staff at the International Congress of Speleology in Kalamos, Greece. The next International Congress of Speleology in 2009 will be in the United States (Kerrville, TX) and hosted by the National Speleological Society. NCKRI staff members will play active roles on the organizing committee, including NCKRI Director Louise Hose serving as Vice- President and Chairman of the Science Committee. The NCKRI staff will organize several pre- and post- Congress field trips in southeast New Mexico.

In addition, the University of South Florida, the University of New Mexico, and NCKRI have worked closely on a major effort to establish a web- based karst portal that will facilitate the transfer of information and resources about karst worldwide. The group has generated worldwide interest in the project and has secured seed funding for the effort. The group is planning a meeting with international representatives in January 2006 in Carlsbad, NM.

Geologic Resources Division Budget

In FY 2005, the Geologic Resources Division funding, including the Challenge addition was:	
Funding allocation in FY 2004	\$2,651,000
Base Change in FY 2005 ¹	25,000
Classified Pay Increase	11,000
Net FY 2005 Decrease ²	(40,000)
Total available in FY 2005	\$2,647,000

In FY 2005, NPS funding for NCKRI was:	
Funding allocation in FY 2004	\$344,000
Base change in FY 2005 ¹	(6,000)
Net FY 2005 Decrease ²	(5,000)
Total available in FY 2005	\$333,000

¹The base increase noted represents the correction to reflect prior year travel reductions properly in various Natural Resources accounts, it is not an actual increase in available operating funds over FY2004.

²The FY 2005 net decrease is the sum of funding changes contained in the Operation of the National Park Service (ONPS) appropriation [e.g., travel reduction, across- the- board reductions].

National Park Service
U.S. Department of the Interior



NPS Geologic Resources Division
P.O. Box 25287
Denver, CO 80225

<http://www.nature.nps.gov/geology/publications/>
(303) 969-2090