

MEETING
SUMMARY

On March 18-19, 2013, the National Research Council's America's Geologic Heritage: A Workshop Committee, with the sponsorship of the American Geosciences Institute (AGI), the Geological Society of America (GSA), the U.S. Geological Survey (USGS), the National Park Service (NPS), and the Colorado Geological Survey (CGS), convened an invitational workshop on America's Geologic Heritage to examine geologic heritage principles and to promote collaboration and cooperation on geologic heritage and geologic conservation in the United States. Participants in this workshop, the first of its kind in the United States, included staff from several U.S. government and state agencies, non-profit organizations, museums, academia, and industry. This meeting took place at the Denver Federal Center, in Lakewood, CO.

Geologic heritage sites are part of a holistic concept of protection, education, and sustainable development and can be designated as "Geoparks." The Geopark should take into account the whole geographical setting of the region and also include sites of ecological, archaeological, historical, and cultural value in addition to those of geological value. The synergy between geodiversity, biodiversity, and culture must be highlighted as an integral part of each Geopark, especially when their importance in relation to landscape and geology can be demonstrated to the visitors.¹

¹ UNESCO (2010). Guidelines and Criteria for National Geoparks seeking UNESCO's assistance to join the Global Geoparks Network.

Geoparks are defined at a landscape scale, and contiguous. Geoparks are not protected areas, and the requirements to set them are less strict than those needed for UNESCO's World Heritage sites. The United States has many areas that could be organized and designated as Geoparks, but none has been yet defined as such.

The meeting was introduced by **Thomas Casadevall** (USGS, Emeritus), who stated that many organizations and individuals are interested in the preservation of outcrops and other features of geological interest around the globe, including the International Union of Geological Sciences (IUGS).

Dr. Casadevall asked the speakers and the participants to consider the benefits of having a geologic heritage program in the United States:

- 1- Improved scientific literacy for the U.S. public: This would be a benefit at K-12 levels, especially because of the lack of consistent Earth sciences curriculum in any U.S. state.
- 2- Improved economic benefit for people, especially in rural and remote impoverished areas, since it can be turned into a major touristic opportunity, as is the case in China.
- 3- Improved health and well-being for Americans, since it will inspire people to explore nature.
- 4- Enhanced geoscience concepts and ideas, including preservation and collections in museums.

The keynote talks were given by **Tim Badman**, Director of the International Union for Conservation of Nature (IUCN)'s World Heritage (WH) program, and by **José Brilha**, President of ProGEO (The European Association for the Conservation of the Geological Heritage) and UNESCO advisor to the Global Geoparks Network. The workshop was structured in five thematic panels, for a total of over 30 presentations: **Values and Relevance**, chaired by Vincent Matthews, CGS/Association of American State Geologists (AASG); **Inventory and Monitoring**, chaired by Bruce Heise, NPS; **Stewardship and Sustainability**, chaired by Stan Finney, California State University, Long Beach; **Museums and Collections**, chaired by James Webster, American Museum of Natural History; and **Education and Outreach**, chaired by Ann Benbow, AGI.

The objectives of this workshop are to begin a dialogue about key principles, sharing of experiences, increasing of awareness, and improved flow of information. We want to also acknowledge the work of Sorena Sorensen (Smithsonian Institution) and, from the National Park Service, Vincent Santucci, Julia Brunner, Tim Connors, Harold (Hal) Pranger, and Lisa Norby in the organization of this event. Full presentations and other information are available at http://www.nature.nps.gov/geology/americas_geologic_heritage/overview.cfm.

Patrick Leahy, AGI Executive Director, reinforced the concept that the United States has many geological sites of interest, and that they need to be thought of in the public context. In the United States there is a disconnected approach, as opposed to the case in other countries with a more integrated approach to outreach (e.g., Canada's Geopark in Stoneham, New Brunswick). As of now, the United States does not have any Geoparks in its territory. The concept of World Heritage (WH) Sites is a United States idea that was brought, in a bipartisan effort, to UNESCO, which subsequently adopted it. The United States was the first signatory. WH Sites have a strong influence on local economies, each bringing approximately \$5 million (U.S.) annually to the local economy. Tourism is the United States' greatest export: the funds come to our country, and the "export" is the experience for the traveler. Even though this is amply documented, people at the local level do not necessarily make this connection. Dr. Leahy stated that the key to success lies in economic benefits and drive, and that strong local involvement and support are crucial to establish any type of park. For a successful park, there needs to be a robust business model with innovative partnerships between local academia, local and state government, and the tourism industry.

The Global Geoheritage Movement, The Big Picture of Conservation

Tim Badman recounted the origins of the geological diversity and geoheritage movement, including resolutions and recommendations approved at the World Conservation Congress (Barcelona, 2008) and the World Conservation Congress' Resolution WCC-2012-Res-048-EN, which stresses

valuing and conserving geoheritage within the IUCN Programme 2013-2016. Currently, there are 217 WH sites around the world. One of the WH sites criteria recognizes geology. Of the 21 WH sites in the U.S., 10 are eminently geologic (such as Yellowstone, Everglades, and Yosemite). Dr. Badman stated that Geoparks need to extend their global coverage to be fully complementary to World Heritage, and that the approach to Geoparks needs to remain consistent as the program grows. There needs to be clarity over the Geoparks concept and the standards of both value and management expected of a UNESCO Geopark². Geoparks can be initiatives responding to the *ad hoc* efforts of nations; however, resources for coordination of Geoparks and consensus on the future development of the concept are needed. As of 2012, there were 90 Geoparks. Regional networks are needed to complement the arrangements in Europe and China, and ensure a greater geographical spread of Geoparks². Key current partners in this process are UNESCO, IUGS, IUCN, and the Global Geoparks Network, with geological surveys, academia, land managers, and extractive industry. Closer partnerships are needed with national and local governments, development agencies, parks services and protected area agencies, the tourism sector, local and indigenous people, and conservation NGOs. Dr. Badman underlined opportunities for U.S. leadership in delivering new leading practice, in showing geodiversity links to biodiversity and cultural heritage, and in promoting and supporting international initiatives, not only a domestic agenda. He encouraged engagement with UNESCO, IUCN, and IUGS in a more ambitious approach to global geodiversity conservation and management.

Principles of a National Geoheritage Program

José Brilha defined geoheritage as geological occurrences with exceptional value. He classified geosites in two categories: *in situ* (natural exposures: including those manmade, such as road cuts) and *ex situ* (geological collections). Geoconservation is an emergent geoscience that is being taught at universities (though not yet in the United States), represented at talks in scientific conferences, and published in peer-reviewed journals. There is a shift from site monitoring to site management. Dr. Brilha stated that many countries are implementing strategies and national programs for geoheritage. These are needed because geologic heritage is a natural resource with usable/economic value; it is non-renewable; it has scientific and educational value; it is affected by threats (such as human development); and has different uses by scientists and by the public. The main aims of a national geoheritage program are science (protect best geosites to allow present and future study), education (formal and informal, as to raise societal awareness), planning (give land managers and administrators the best information and tools to include in conservation

² Calnan, R., S.R. Brady, and W. Hill. 2010. Geoparks: Creating a Vision for North America. *The George Wright Forum* 27(1): 40-45.

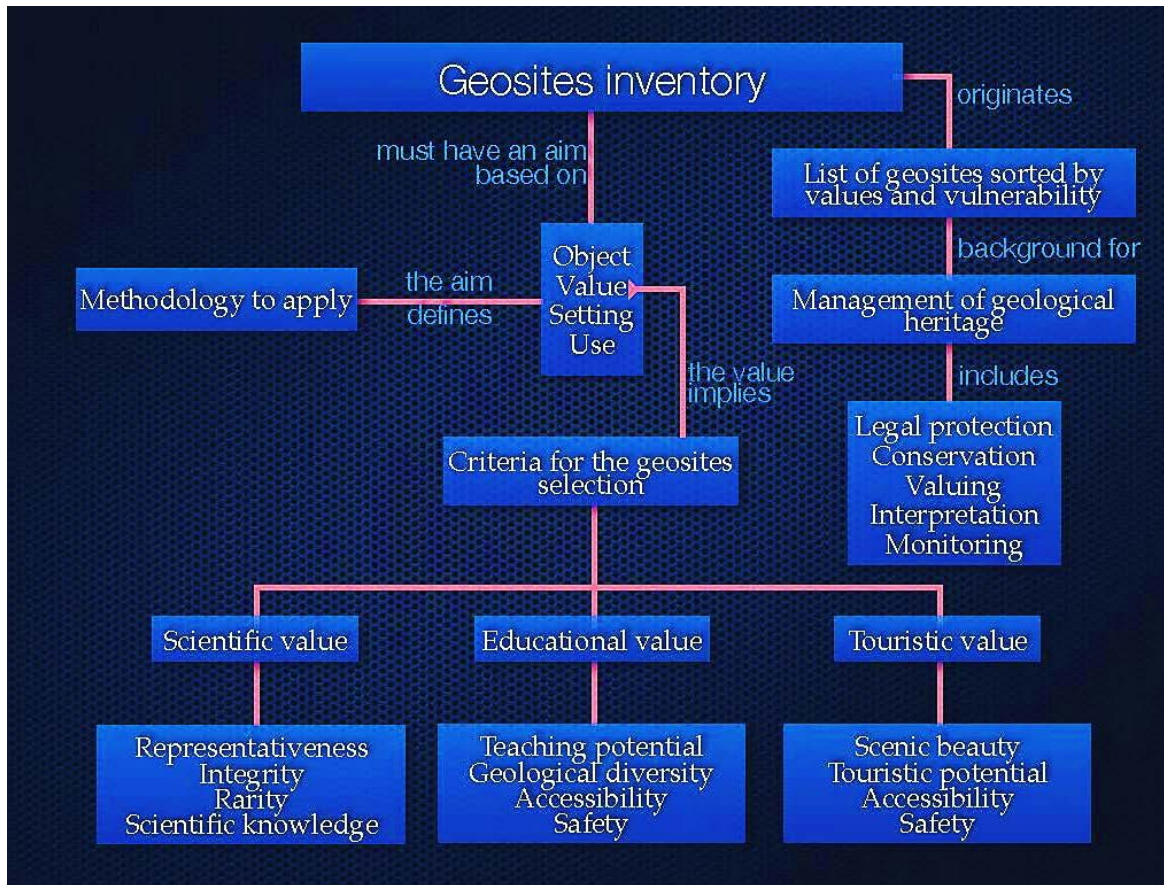


Figure 1. Geosites Inventory Process.

Source: José Brilha, University of Minho, Portugal, March 18th presentation to the National Academies America's Geological Heritage Invitational Workshop.

strategies), and sustainable tourism (which raises income levels of local communities). Park managers need to be aware of the geological significance and importance of their sites, which might be preserved with a relatively small amount of money. Part of the implementation strategies are inventorying the necessary first step (see Figure 1); characterization and assessment (including vulnerability); legal protection; conservation; valuing and interpretation; and monitoring. Dr. Brilha suggests that a national geoheritage inventory would be the first step to ensure successful conservation and management of U.S. geosites. In Europe, ProGEO involves 36 national groups (almost all European countries), and national and regional geoheritage inventories. Working beyond national frameworks for the protection of Europe's typical and important landscapes with the greatest scientific and cultural importance, they organize and participate in European geological conferences and workshops and produce publications. The European Geoparks Network consists of 52 Geoparks in 18 countries. Of special note are the experiences of the United Kingdom, which has selected ~3000 geosites, 1000 of which have legal protection; of Spain, with its Geological Survey's Department of Geoconservation dedicated to the development of an inventory of geosites, promotion of geoconservation science, and legal protection; and of Portugal, which included geosites in its national conservation legislation and inventory and has a M.Sc. program in Geoconservation at the University of Minho.

James Wood (NPS) affirmed that geologic heritage's status in the U.S. ranges from absence at geology meetings to a great presence in National Parks. There are iconic resources in the U.S., such as World Heritage Sites, National Natural Landmarks (NNLs), the National Landscape Conservation System, the National Forest System, Public Lands, and the National Park System. There are protections, such as environmental laws (Clean Air Act, Clean Water Act, NEPA), and Acts (Antiquities, Caves, Paleontological, Geothermal). Mr. Wood declared that heritage is the patrimony shared by all, and that America's geologic heritage extends from museums to landscapes: it is a mosaic, a combination of tangible and intangible elements, the history that plays out on the landscape. The influence of geology is pervasive throughout America's history. The protection of America's geologic heritage goes back to the Yellowstone Act (1872) and the 1906 Antiquities Act, which establishes presidential authority to create a National Monument and led to the preservation of many of the country's most iconic places: the first one was established that same year in Devils Tower, WY. "See America First!" was one of the earliest tourism campaigns with a distinctive geological approach, and needed local support to make it work. Geologic heritage resources can be in designated (e.g., national parks, public lands, scenic byways, etc.) or undesignated areas (e.g., scenic overlooks and road cuts). Significance implies the specification of criteria and of their use to determine protection. Mr. Wood underlined that boundaries are not the

same as protection: not all elements within a boundary are significant, and not everything that is significant is designated. Designated areas can be assigned into many different classifications. Scientific geologic heritage resources span both designated and undesignated areas, and include, among others, type sections, specimens, ice cores, and data sets. Geologic heritage conservation needs partnerships from museums and collections, the geoscience and education communities and resource management specialists. As an example, the 2012 National Fossil Day, held every year in October, counted 225 partners.

Vincent Matthews (CGS/AASG), speaking on behalf of Vincent Santucci (NPS), introduced the **Theme Session on Values & Relevance** and spoke about values: aesthetic, scientific, educational, recreational, commercial, and spiritual. Workshop participants were given the opportunity to contribute their own ideas of values related to geologic heritage in separate cards, which they sorted under one of 15 categories: cultural, scientific, education, aesthetic, historic, preservation, commercial, recreation, legacy, type locality, outreach, religious/spiritual, sense of place and time, tying of geology and ecology, and geohazard awareness. Dr. Matthews introduced a series of case studies.

Steven Semken (Arizona State University) stated that “a *place* is any locality, real or imagined, that becomes imbued with meaning by human experience. As we affix intellectual meanings to places, we also form emotional attachments to them, individually and collectively. *Sense of place* comprises the meanings and attachments made in and for a given place. The sense of place operationalizes the connection to Earth.” Geologically iconic places will have different meanings to different people. Sense of place and its components, place meaning and place attachment, can be characterized, measured, and assessed quantitatively (e.g., surveys) and qualitatively (e.g., focus groups, interviews, observation) and by indirect artifact analyses in ways of potential value to geologic heritage. These places are central to cultural identity and sustainability. Native American peoples have stories attached to sacred places and believe that people are relatives to their homelands (“kinship” and “homeland” words have common roots in the Diné language). They foster reverence and care for sacred sites, which are not necessarily private or prohibited.

Vincent Matthews described efforts in Colorado Geoheritage (and states in the vicinity: Arizona, New Mexico, Wyoming, and Utah). Colorado established the Colorado Natural Areas Program (CNAP), which provides guidelines for the protection of the best natural features in Colorado. CNAP works cooperatively to conserve ecosystems, species, geology and fossils “uniquely Colorado.” The Colorado Natural Areas Act of 1977 provides necessary guidelines to ensure Colorado's natural heritage through the identification, registration, designation, and protection of qualified natural areas of statewide significance, but there is no legislation mandating

their protection. Colorado designated 18 natural areas as having outstanding geologic resources. The participants discussed that it is important to inventory potential Geoparks in the various states and add geological interpretation to the already existing biological interpretation in state parks. Another topic of general comment was the need to tailor the geoheritage message to the new generations and use social media, since this is how many people get their information. Another suggestion was made for a state office, a geologic historic preservation officer position similar to the State Historic Preservation Office (SHPO).

The **Theme Session on Inventory and Assessment** was coordinated by **Bruce Heise** (NPS Geologic Resources Division, GRD), who introduced five case studies that go from broad to specific, and touch on four considerations: components (terminology), methodology (utility), gaps, and connections. **Timothy Connors** (NPS/GRD) described the NPS' Geologic Resources Inventory (GRI). This NPS division produces the National Parks' geologic maps as one of their 12 basic inventories to capture baseline information for science-based park resource management. Digital geological maps are needed, as well as special purpose maps (e.g., hazards maps) specific to each park. Mr. Connors presented the methodologies used to inventory and assess geologic heritage areas, including landscapes and features, identified gaps in current efforts that hinder the geologic heritage program, and drew connections between inventory and assessment, sustainability, and stewardship with museums and collections and with education and outreach. By 2016 all national parks should have a foundational document that includes the history of the area beyond the map: a geologic report that links the map and the park manager to the landscape. All these reports are to be published online. Partnerships are integral (e.g., CSU, USGS, AASG, GSA, NOAA, AGI) to complete the GRI and participate in outreach.

Melody Holm (U.S. Forest Service, USFS) stated that the geoheritage concept is not yet used at USFS. Holm described the USFS' management framework, where Land and Resource Management Plans include conditions, objectives, standards, guidelines, suitability of lands, and, optionally, goals. Some of the specially designated areas have a geological basis or component. In the 2010 review and compilation of areas there are two categories: (1) statutorily designated: national monuments, national landmarks (resulting from the 1935 Historic Sites Act), and national areas, and (2) administratively designated: geologically special areas, research areas, points of interest, and other notable sites/features popular with the public that are not included in other categories. The list of sites is not yet complete, and there are opportunities for additional designations, research, education, and interpretation.

Herb Meyer (NPS) talked about the inventory and monitoring of paleontological sites and presented two specific examples: Florissant Fossil Beds National Monument, CO (so designated in 1969 to protect it from development, and which helped

establish environmental law) and Piedra Chamana Petrified Forest, in Sexi, Peru. Florissant and Piedra Chamana are sister parks.

The *inventory* documents locations and baseline conditions using GPS (precise location of fossil sites, map the boundary outlines and plots significant features) and photography (establishment of photo points and baseline photographs), and is the basis for the compilation of a manual. The *monitoring* consists on the observation and evaluation to assess changing conditions at specific intervals, assessment of their condition using a scoring matrix, recording of their status using repeat photography, and maintenance of the records in a database. The evaluation of condition includes parameters of disturbance, fragility, fossil abundance, loss, and accessibility, and allows for a systematic and measurable observation of changes due to human impacts, such as vandalism, and natural processes impacts, such as erosion.

Lenore Bates (Colorado Department of Transportation-COLORADO Scenic Byways) described the 25 Colorado Scenic and Historic Byways, of which 11 are nationally designated. The department has developed an online kit for the development of new scenic and historic byways, which includes six intrinsic qualities: archeological, cultural, historic, natural, recreational, and scenic. Of great importance is the development of the "byway story" and the byway inventory with the involvement of the local community, with the ultimate goal of identification of the byway corridor. The program has not been funded since 2012, but it continues only because it is a true grassroots effort with clear economic value.

Harley Armstrong (U.S. Bureau of Land Management, BLM) discussed geologic heritage resources on BLM Public Lands. BLM manages both surface and subsurface of the lands, primarily located in 12 western states. Some public lands are devoted to multiple uses, while others are used for mineral exploitation. Among the topics of geologic interest to Colorado are abandoned mine properties, oil and gas and minerals, fossils, interpreted areas, the National Landscape Conservation System (NLCS), and Areas of Critical Environmental Concern, with endangered plants and animals that live on lands of geologic interest.

To wrap up the session, **Bruce Heise** discussed the NPS/USGS Partnership, where the USGS National Cooperative Geologic Mapping Program, with its component elements, is the link between NPS and USGS for geologic park mapping. During the group discussion, participants discussed the issues of maps and methodology, where there is a need for methodical exploration and standardization, in addition to the need for more people and resources. There are gaps where different people have different interpretations about inventory.

The *second day of the meeting* started with a recap of the previous day, where **Lisa Norby** underlined that geologic heritage work is being done, but that better coordination is

needed. **José Brilha** asked participants to be part of a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis by proposing that they write their thoughts about geologic heritage and place them under one of those four categories. He noted that there were more opportunities mentioned than elements in any of the other three categories. A summary of the SWOT analysis can be found in Figure 2.

The first session of the second day was a **Theme Session on Sustainability & Stewardship**. **Stan Finney** (California State University-Long Beach, and chair of the IUGS' International Commission on Stratigraphy) discussed the designation and preservation of Global Stratotype Sections and Points (GSSPs), which are international geostandards that define the units and boundaries of the geologic time scale. The goal is to define a full International Chronostratigraphic Chart at the period, epoch, and age ranks defined by boundaries: points in rock successions. Abundant, distinctive fossil flora and fauna are especially useful to match these points worldwide. "Golden Spikes" marking these areas are being placed around the world. In some countries, such as China and Spain, the placement of a new golden spike is accompanied by a spectacular rollout event. There are seven GSSPs in the United States, but most are unmarked sites found on public lands. Proper marking and educational displays, preferably with local involvement, would be advantageous.

Ken Mabery (NPS) underlined the importance of consulting with geoscientists to establish certain park elements, such as roads and buildings, and not rely only on the expertise of landscape architects. Dr. Mabery discussed the need to engage both the general and the scientifically educated public with tailored approaches. Some of the strategies NPS uses are local partnerships (i.e., with site stewards, who can help measure, monitor, and protect); invoking cultural context, since when people learn of other cultures' attachment to the physical world (i.e., Native American and settlement-era folklore) they form emotional attachments; and environmental education and outreach with emphasis on children, since it is most effective to educate the youth. Other strategies are marketing, to get the message across in a succinct, powerful way (a 7-word story so it can be "marketed" and "bought" by the public); tourism, to engage the public using social media and graphics; and public affairs, to structure the story effectively in the short and long term. Dr. Mabery stated that there is a need to change internal agency perceptions to make this new approach viable, and gave the example of the effective marketing of the NNLs.

Peter Frenzen (USFS) spoke about the process of creating and sustaining a geologic "park," using Mount St. Helens as an example. The 1980 eruption seriously impacted natural resource management and the local timber-based economy, but created new opportunities for scientists. There is great public interest in this site, which was established as a National Volcanic Monument on USFS land in 1982 to protect natural processes and features and provide for recreation, public

safety, and scientific research. Capital investment and development followed, and three visitor centers were established. Among the main characteristics of the Monument are message-based interpretation programs to reach diverse audiences, effective partnership with the scientific and local communities, strong trained volunteer component (dispensable to sustain the program), protection of the core mission, development of recreational uses and scientific and learning center programs, and the establishment of a website. Because of funding issues, some visitor centers had to be closed, and a coalition of scientists, educators, and non-profit partners are working toward repurposing them.

Melissa Smeins (U.S. BLM) talked about sustainability and stewardship in BLM public lands, specifically in the Garden Park Fossil Area, which contains fossils, rare plants, and history, and is part of the Gold Belt Byway Association in Colorado. The U.S. BLM and NPS, together with other partners, are working on the proposal to make the Gold Belt Byway a Geopark, since their respective goals are similar. The Gold Belt Byway includes Cripple Creek, Victor, Florissant, Florence, and Cañon City, and has geology and type fossil localities including a NNL site, the Florissant fossil beds, and the Cripple Creek/Victor mining districts. A Geopark designation will have the benefits of highlighting geologic significance, international recognition, and participation in joint initiatives. Among the concerns are funding availability and that not all entities might want to participate because of UN involvement, which is unfamiliar to some U.S. citizens in rural areas. The options for the future are

to continue the pursuit of Geopark designation, leave the Gold Belt Byway alone, enhance Byway objectives with geologic heritage story, or pursue another type of designation.

Heather Eggleston (U.S. National Natural Landmarks Program, NNL) described this NPS-administered program founded in 1962. These NNL sites are designated by the Secretary of the Department of the Interior, but NPS does not manage or own the sites, and access and land-use activities are not changed. Among the 594 NNL sites to date, approximately one-third are publicly-owned, one-third private, and one-third mixed public/private-owned. The full designation process takes 2-3 years. The establishment and management of these sites create and cultivate conservation partnerships and promote geologic heritage through technical assistance to assess site condition and provide management recommendations, through small grants for specific needs, through advocacy and outreach to other agencies, and through raising public awareness, including a website, an annual photo contest, and events.

The **Theme Session on Museums and Collections** was coordinated by **James Webster**, American Museum of Natural History (AMNH), who described the holdings and activities of the AMNH related to Earth Sciences and Geologic Heritage. Of the over 5 million specimens related to Earth sciences, only 2 percent are on display, and stored materials are available for research. Their location in New York City and the 5 million annual visitors they receive present an excellent opportunity

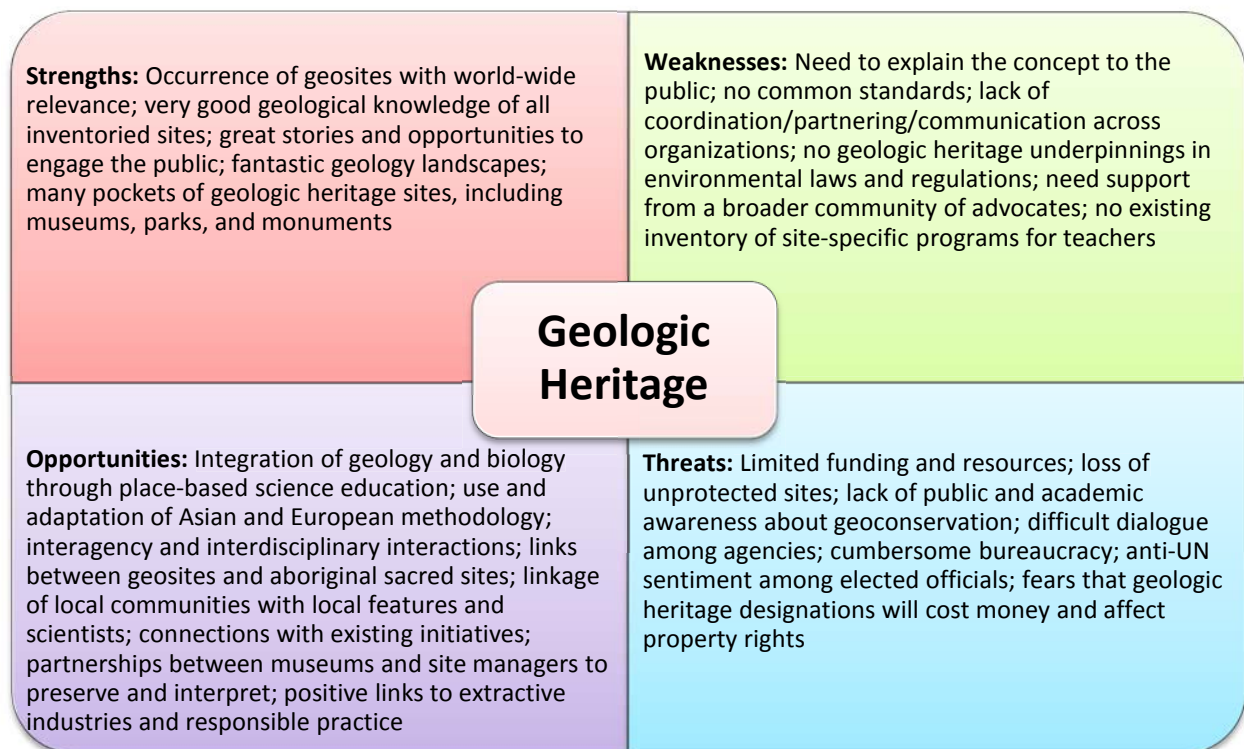


Figure 2. Geologic Heritage Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis: salient examples provided by some of the participants.

Source: Figure prepared by Ester Sztejn, March 18-19, 2013

for education and outreach to a variety of stakeholders, including media. One consideration is how to engage industry, especially mining companies, in geologic heritage, since they have a responsibility in educating the public. Abandoned mines could be used in tourism and education activities. **Ian Miller**, from the Denver Museum of Nature and Science, the 4th largest museum in the United States, talked about their formal mission—to-preserve and protect, and their informal mission—to inspire curiosity and excite minds—for which they focus on communications to the public to develop in them a sense of deep time and a sense of place, especially in what it relates to Denver and its basin. Their leitmotif is "Time Traveling with a Shovel." Collaborations between scientists and artists help the public visualize processes and minerals and need to be fostered.

Martin Lockley (University of Colorado, Denver; Dinosaur Trackers Research Group) shared with the participants information about the Fossil Footprint database. He described the imprints left by dinosaurs in track sites as "ancient landscapes," since they represent living, dynamic creatures (as opposed to fossil bones). These sites can be incorporated into museum exhibits, and track collections can be used in public education. A prime example is Dinosaur Ridge (Morrison, CO), which is also a NNL site. The database currently has 1,200 sites, mostly in the western United States. Some track sites have been nominated for World Heritage Sites.

Greg McDonald (NPS) discussed collections from geologic heritage sites, conceptualizing them as natural bridges between protected areas and museums. Managers of sites designated for preservation need to track information about the institutions involved in collecting, the specimens and their current location, and other important collection data. Information such as spatial and stratigraphic distribution and degree of taxonomic diversity contribute to sound management decisions. In contrast, institutions holding those specimens usually lose interest in the source sites, including their long-term preservation. Though at different scales, collections and their source sites help understand the history of the Earth. The loss of one diminishes the scientific, aesthetic, intellectual, and interpretive value of the other. Preservation of sites allows for researchers to return to the original sites and reexamine them applying new ideas and/or new technology. Among his suggestions are to construct a shared online comprehensive illustrated database of specimens and their current locations linking them to their original sites, inclusion of references to geologic heritage sites when displayed in museum exhibits and vice versa, and an online bibliography of literature about the site and specimens from the site, including both scientific and popular articles.

Wendy Harrison (National Science Foundation, Colorado School of Mines) provided the perspective of NSF, which supports research, innovation of research, science, and both informal and formal education. Dr. Harrison said that NSF needs to help facilitate the broader impact aspect of the

awards, making it easier to work with museums, K-12 level students, and others. Geologic heritage can be a tool to achieve broader, measurable impact.

The **Theme Session on Education & Outreach** was coordinated by **Ann Benbow**, AGI, who also described the successes and challenges of Earth Science Week. This AGI weeklong celebration of Earth science, started in 1998, is always held during the second full week in October. It has a well-developed website, a newsletter, and uses social media for outreach tools. It provides 16,000 toolkits with teaching materials that reach 50 million people. The theme changes every year. The roots of its success reside on engaging themes, stalwart partners (such as USGS and NPS), dedicated staff, excellent materials for educators, special online features, a great network (USGS, federal agencies, state surveys, educators), regular communication, funding support, and providing opportunities for participation. Among the challenges are securing funding, reaching the general public, overcoming poor perception of Earth science in schools (particularly at the high school level), mail/printing costs, identifying themes with broad appeal, and locating new partners.

Bill Rose and Erika Vye (Michigan Technological University) described their work on building grassroots for a Geopark in Michigan with strong place-based educational use. There is a Geopark proposal in development for Isle Royale and Keweenaw: the former is a wilderness National Park, while the latter is a mining history-focused National Park. Partners in the proposal include two universities, NPS, state parks, and local communities. It is important to work incrementally and build demand. Activities already underway are the Keweenaw Boulder Garden, the involvement of a graduate class in the development of a smartphone (Geotracker) application, the development of a geologic website that includes a virtual field trip, and a walk/bike tour of the city that uses GPS/smartphone apps and QR codes to get explanations. The Michigan Teaching Excellence Program (MITEP) allowed 50 teachers to do NPS internships that include field work and provide excellent professional development opportunities. Among the main challenges are public perception (concerns regarding access and about the UN), reduced opportunities for educators to apply their new knowledge, and new mining exploration in the area.

Dave Mogk (Montana State University) talked about the preservation of geologic field sites from the perspective of undergraduate instruction. He stated the many benefits of field work, including cognitive gains not attained in any other learning environment, affective gains such as motivation, curiosity, and self-confidence, and that field work is central to geoscience education. Even so, field work is in jeopardy because of cost and time liabilities, emphasis shift to modeling, and changed access to field sites. Dr. Mogk expressed the need for local, regional, national catalogues of "iconic" field sites with exceptional educational values (road log/field trip/guide databases), online teaching activities developed for the sites

for all educational levels, and field activity exercises, emphasizing the need of knowing what key geologic features to look for in order to increase enjoyment and understanding.

Carolyn Driedger (USGS Cascades Volcano Observatory, WA) discussed the role of Geoparks in preparing citizens to live safely with volcanoes. She presented "Living with a Volcano in your Backyard," their Mt. Rainier outreach campaign, where they translate research results to stakeholders such as policy makers, educators, media, and geopark staff via specially-targeted products. Dr. Driedger highlighted the importance of developing consistent and complementary messages conveyed in multiple venues, and the interaction with social scientists for values-driven messaging, which helps understand what motivates people and suggest actionable preparedness actions.

Lastly, **Jane Mannon** (Cripple Creek and Victor Gold Mining Company, CO), discussed mining industry outreach and mineral education programs, including participation in the Gold Belt Byway. The Southern Teller County Focus Group has a network of trails on mine property, with interpretations of the geology of the area. With approximately 15,000 visitors a year, trails reduce trespassing and provide information and legal access to property. In these types of partnerships, companies look for a wide range of community support, recognition of the partnership by the public, synergies on education, and making the place better for everyone.

In the **Conclusion Panel**, **Wesley Hill**, GSA's Geoheritage representative, proposed to see America's geologic heritage as a national partnership, as interconnections within a national platform. The National Park Service is hailed globally for their best practices, but America's voice is missing at the international level: the global arena would like to see Americans joining the dialogue and sharing practices. The benefits of a strong geoheritage program are many: scientific

literacy by the public; scientific research, museums, GSSP protection, and iconic sites; access to education; economic benefits; resource extraction; and securing the value that society and the scientific community place in geologic heritage. It represents the story of America's history. Ms. Hill suggests that next steps should include inventory, characterization and assessment, regulations and protection measures, monitoring, and education and outreach.

Patrick Leahy (AGI) added that only some of the great geologic heritage opportunities in the U.S. are realized. While peer-reviewed research references are well catalogued, data accessibility is bad because of lack of central repositories. NSF's EarthCube³ might be the solution to this problem. Also necessary is a national inventory (for which state surveys, museums, local groups need to be involved), information on number of visitors, a discussion on standards, and expansion outreach to geoscience colleagues and to new groups such as the National Science Teachers Association, Byways, and mineral societies. There needs to be a plan to visualize what U.S. geologic heritage should be in 20 years, and ideas about a geologic heritage funding model.

The participants had the opportunity to offer closing thoughts in a round-robin format facilitated by **Lisa Norby**. Various participants highlighted several essential elements of America's geologic heritage: geologic heritage is an integral part of our history and cultural identity and is a way to learn and teach about Earth's dynamic systems; it is beneficial to the nation and engages various communities; consists of special areas that are vulnerable to loss; and some of the people that can effect geological heritage preservation are already engaged at many agencies and programs around the country.

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³ <http://earthcube.org/>