

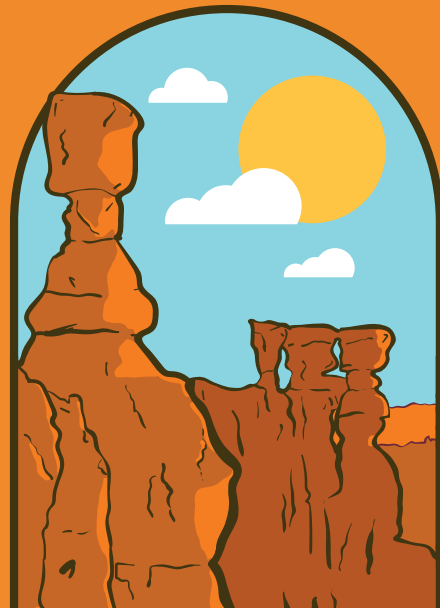
U T A H G E O L O G I C A L S U R V E Y

SURVEY NOTES

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75 YEARS | 1949-2024

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DIRECTOR'S PERSPECTIVE

by Bill Keach

When was the first time you picked up a rock with a curious eye, asking yourself, "I wonder what it is?" Folks at the UGS have been answering that question for many years. The birth of the "modern" Utah Geological Survey occurred in 1949 when it was integrated into the University of Utah. Over the years the name and where it lived have evolved. Looking back at its origins provides some insight into what we do today.



In 1951 the new Survey issued a "second impression" of a 1948 report on *Fluorite in Utah*. It was the first publication released since the Survey was established July 1, 1949. At the time fluorite was a sought-after mineral with many uses. Utah production increased 500% in 1948.

The Survey's first director, Arthur Crawford, included two introductory pages in the report. The first describes the statutory responsibilities of the new survey—there were seven of them. Briefly, the Survey was tasked to collect and distribute "reliable information regarding the mineral resources of the state" with "special reference to their economic contents." They were further charged to work cooperatively with other state and federal agencies and to share the information with the public.

The core responsibilities from 1949 remain the same today with programs focused on mapping, energy and minerals, hazards, and outreach. We have expanded into other areas: earthquake hazards (1977), groundwater (1994) and wetlands (2010), and paleontology (1995).

The second page of the report sounds eerily familiar to budget uncertainties we work with today. The transfer of the new Survey to the University of Utah was largely unfunded. Crawford lamented the Survey received a "limited appropriation" which hindered what they could deliver. (They received \$25,000 to support 3–4 staff for the first two-year period. Even less the following two years.) He stated, "we cannot hope to publish the results of some of the detailed investigations which otherwise would have been completed and released to those needing these geologic studies."

Our budgets and staff numbers are much larger now. UGS funding sources are often unpredictable (a portion being dependent on prices and production of oil, gas, and minerals). In down years, the UGS has lost staff due to significant drops in funding. In these years, we significantly cut back on what we can deliver, just as Arthur Crawford did in his time. Other years, we fare much better. This year, none of our new funding proposals were included in the new fiscal year budget. Being ever optimistic and true to our mission we will chase them again next year.

In the past 75 years the UGS has published 2,474 articles, papers, and maps. The previous UGS Director, Rick Allis, made it a priority to make all of our work freely available on the web. Today it is all there. The UGS website is considered an example of "how to do it." We now host 35 web apps, for everything from rockhounding to geologic hazard maps. We support 727 pages on the UGS website that provide timely, scientific information about Utah's geologic environment, resources, and hazards—thus fulfilling the same mission we had in the beginning, 75 years ago, to collect and distribute "reliable information regarding the mineral resources of the state." ■

A Brief History of the UGS

This year marks the 75th anniversary of the Utah Geological Survey (UGS). In 1949, the Utah Geological and Mineralogical Survey was created within the University of Utah's State School of Mines and Mineral Industries. Today, the UGS is a state executive branch applied science agency within the Utah Department of Natural Resources (DNR). The UGS currently comprises six technical programs—Energy & Minerals, Geologic Hazards, Geologic Mapping & Paleontology, Groundwater & Wetlands, Geologic Information & Outreach, and Data Management—and has a Geographic Information Systems (GIS) group that provides key support for data analysis and release. Additionally, the UGS operates the Utah Core Research Center, UGS Library, and the Natural Resources Map & Bookstore retail outlet. Most of our approximately 90 employees work out of the main Salt Lake City office, and five staff work out of the Southern Utah Office in Cedar City.

To mark the UGS's 50th anniversary, a timeline of important events in the history of the UGS from 1949 to 1999 was published in *Survey Notes* (v. 31, no. 3). The following summary highlights some of the important events that occurred in the 25 years since then. The complete 75-year history can be found online at <https://geology.utah.gov/75-year-timeline>.



Former UGS Directors Rick Allis, Lee Allison, and Genevieve Atwood at the 2009 Association of American State Geologists (AASG) annual meeting in Park City, Utah.

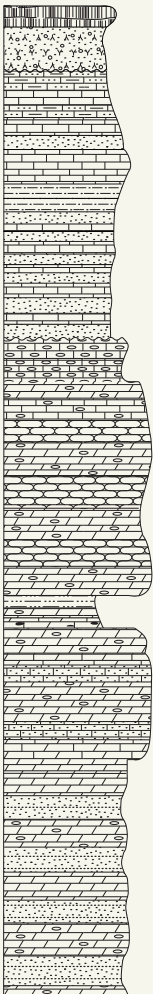


A track hoe pulls the nine-ton field jacketed Utahraptor Megablock from the Stikes quarry in eastern Utah, March 2015.

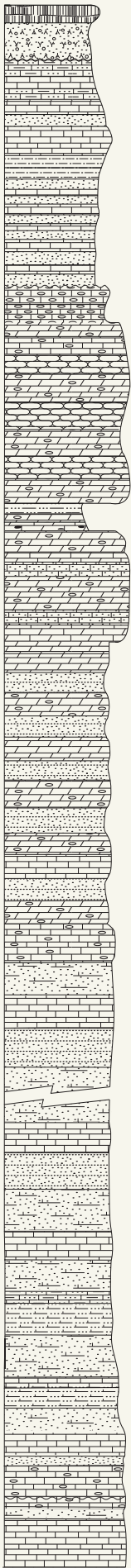


Ben Sears with students at the Earth Science Week paleontology station, 2022.

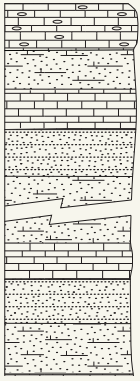
Timeline of Events 1999-2024



- 1999** Director Lee Allison steps down, Deputy Director Kimm Harty assumes role as acting director. UGS establishes the Crawford Award, named after Arthur L. Crawford, to recognize outstanding achievement, accomplishments, or contributions by current UGS scientists to the understanding of some aspect of Utah geology or earth science; David Madsen is the first recipient of the award.
- 2000** Dr. Richard G. (Rick) Allis is appointed as the Survey's sixth director; Rick establishes a priority of making all UGS information and reports available through the UGS website.
- 2001** Several UGS programs are renamed to more clearly highlight the focus of their work: "Applied Geology" becomes "Geologic Hazards," "Economic Geology" becomes "Energy and Mineral Resources," and "Geologic Extension Services" becomes "Geologic Information and Outreach." The State of Utah transfers the Energy and Resource Planning Office, comprising three staff, into the UGS for a brief period of time. UGS hosts the first annual Earth Science Week activities for school kids at the Utah Core Research Center (similar activities were previously offered as part of Utah's Prehistory and Heritage Week celebrations).
- 2002** UGS Southern Utah Regional Office moves from its location on the campus of Southern Utah University to office space on Fiddlers Canyon Road in Cedar City.
- 2003** Utah Geological Association and UGS establish the Lehi Hintze Award for Outstanding Contributions to the Geology of Utah; Dr. Lehi Hintze is the award's first recipient (see the list of other UGS employees who have received the Hintze Award on page 3). American Association of Petroleum Geologists Annual Convention and Exhibition is held in Salt Lake City, Tom Chidsey serves as General Chair.
- 2004** Mike Lowe receives the DNR Manager of the Year award.
- 2005** State legislation transfers the State Energy Program (SEP), formerly of the Utah Energy Office, to the UGS; the five SEP staff provide direct support and access to federal funding for energy efficiency, energy conservation, and renewable energy programs and projects in Utah. UGS "Environmental Sciences" program changes its name to "Ground Water and Paleontology."
- 2006** Dr. Wally Gwynn is named as the first recipient of the Director's Sovereign Land Award from the Division of Forestry, Fire and State Lands, for his outstanding achievements and contributions to the history, science, and well-being of Great Salt Lake. Kimm Harty receives the DNR Manager of the Year award.
- 2007** UGS produces the inaugural annual *Calendar of Utah Geology*, presenting scenic geology photos taken by UGS staff. The "Energy and Mineral Resources" program shortens its name to "Energy and Minerals."



- 2008** Partnering with several entities, UGS helps create and open the G.K. Gilbert Geologic View Park at the mouth of Little Cottonwood Canyon in Salt Lake County. Utah Core Research Center undergoes expansion and improvements including a larger classroom space for meetings and workshops, a digital imaging lab, a microscope examination room, and new office space for visiting scientists and researchers. Janae Wallace and Mike Lowe receive the Calvin K. Sudweeks Award from the Utah Water Quality Board for leadership and achievement in the field of water quality improvement in the State of Utah.
- 2009** Bill Lund is awarded the 2009 Governor's Medal for Science and Technology. UGS hosts the annual meeting of the Association of American State Geologists in Park City.
- 2010** UGS expands its scope of water-related research by hiring a wetlands specialist into the Groundwater and Paleontology program.
- 2011** State legislation transfers the State Energy Program out of the UGS and into the newly created Office of Energy Development.
- 2012** UGS receives the Western States Seismic Policy Council 2012 National Award in Excellence for Research for the ongoing work of the Utah Earthquake Working Groups, convened under the auspices of the UGS in cooperation with the Utah Seismic Safety Commission and U.S. Geological Survey. Buck Ehler receives the DNR Manager of the Year award. Two dinosaurs are named in honor of UGS employees: *Martharaptor greenriverensis* (Martha Hayden) and *Yurgovuchia doellingi* (Hellmut Doelling).
- 2014** UGS paleontologists successfully collect a 9-ton, fully intact sandstone block containing thousands of bones belonging to *Utahraptor* dinosaurs and other species. The "megablock" is transported from its collection site near Arches National Park to the North American Museum of Ancient Life at Thanksgiving Point in Lehi, Utah, where fossil preparation work begins.
- 2015** UGS Southern Utah Regional Office moves into the newly completed Department of Natural Resources Southwest Regional Complex in Cedar City. Tyler Knudsen, Paul Inkenbrandt, Bill Lund, Mike Lowe, and Steve Bowman receive the 2015 John C. Frye Memorial Award in Environmental Geology, from the Association of American State Geologists and the Geological Society of America.
- 2016** Due to sharp price drops for oil and natural gas as well as reduced production on federal lands, Mineral Lease revenues to UGS decline by 60% between 2014 and 2016, prompting a reduction in full-time-equivalent staff from 80 to 65. UGS receives the Western States Seismic Policy Council 2016 National Award in Excellence for Educational Outreach to Business and Government, for the Basin and Range Province Seismic Hazards Summit III.
- 2017** UGS "Groundwater and Paleontology" program becomes "Groundwater," as the paleontology staff transfer to the Geologic Mapping program. Bob Biek leads the Geological Society of America Thompson Field Forum, showcasing two of the largest terrestrial landslides on Earth, recently recognized and documented in Utah by Bob and colleagues. Steve Bowman and Bill Lund receive the Claire P. Holdredge Award from the Association of Environmental & Engineering Geologists, for their publication of geologic-hazard investigation guidelines.
- 2018** Utah Legislature names *Utahraptor* the official state dinosaur; *Utahraptor* was discovered by Jim Kirkland in 1990. Tom Chidsey receives the 2018 Public Service Award from the American Association of Petroleum Geologists. Hellmut Doelling receives the Governor's Distinguished Service Award, honoring 65 years of service to the State of Utah. American Association of Petroleum Geologists Annual Convention and Exhibition is held in Salt Lake City, Michael Vanden Berg serves as General Chair.
- 2019** Rick Allis retires after 18 years as UGS director and State Geologist. R. William (Bill) Keach II is appointed as the Survey's seventh director; Bill establishes two priorities for the UGS: 1) stabilization of ongoing funding, and 2) outreach to the public and the Utah Legislature. Partnering with several entities, UGS helps create and open the Park City Sunrise Rotary Regional Geologic Park near Park City in Summit County.
- 2020** UGS "Groundwater" program changes its name to "Groundwater and Wetlands" to reflect its growing emphasis on wetlands research. *Utahraptor* "megablock" is moved from Thanksgiving Point to recently renovated space in the Utah Core Research Center. COVID-19 pandemic prompts the State of Utah to implement a telework directive; two days after nearly all UGS staff began working from home, the magnitude 5.7 Magna earthquake strikes Salt Lake Valley; UGS office experiences minimal damage.
- 2021** Utah Legislature creates the Utah Geological Survey Oil, Gas, and Mining Restricted Account, intended to use deposits of severance tax revenue to help offset volatility of Mineral Lease revenue to the UGS. The Web Services Section of the Geologic Information and Outreach Program is reorganized into the Data Management Program. Tom Chidsey receives the Robert J. Weimer Lifetime Contribution Award from the Rocky Mountain Section of the American Association of Petroleum Geologists (AAPG). Michael Vanden Berg receives the 2021 Distinguished Service Award from AAPG.



- 2022** UGS receives the Best Use of Social Media award at the 2022 Utah Digital Government Summit, for the Arch Challenge social media campaign.
- 2023** Stemming largely from UGS outreach efforts to legislators and water district managers, Utah Legislature appropriates \$50 million to improve the seismic resilience of Wasatch Front aqueducts. UGS hosts the 14th Mesozoic Terrestrial Ecosystems paleontology conference, the first time this international conference is held in the U.S.; Jim Kirkland is recognized for 50 years of outstanding contributions to the field of paleontology. UGS Earth Science Week team (Stephanie Carney, Mackenzie Cope, Jim Davis, Torri Duncan, Mark Milligan, and Jackson Smith) receives the DNR Community Outreach Award.
- 2024** New legislation provides for deposits of Mineral Lease revenue into the UGS restricted account, as another means of reducing budgeting uncertainties associated with volatile Mineral Lease revenue. UGS to host the annual meeting of the Association of American State Geologists in Park City in June. ■



Screenshot of the online Geologic Map Portal showing an oblique view of Mt. Timpanogos and Provo Canyon from the south.

Signs on display at the Park City Sunrise Rotary Regional Geologic Park in Summit County, Utah.

UGS Deputy Director Mike Hylland, former UGS Director Genevieve Atwood, and UGS Director Bill Keach at the 2019 AASG annual meeting in Butte, Montana.

Lehi Hintze Award

In 2003, the Utah Geological Association and Utah Geological Survey established the Lehi Hintze Award for Outstanding Contributions to the Geology of Utah. Dr. Lehi Hintze, the award's namesake, was honored with the inaugural award for his outstanding body of work completed during a long and noteworthy career with Brigham Young University and the UGS. Other UGS employees who have received this prestigious award include the following:



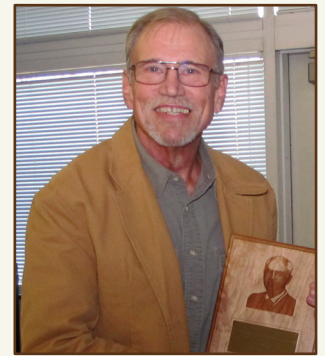
2003 Lehi Hintze



2004 Hellmut Doelling



2010 Gary Christenson



2012 Bill Lund



2015 Doug Sprinkel



2016 Genevieve Atwood



2017 Tom Chidsey



2019 Grant Willis



2022 Ken Krahulec

The UGS Program Evolution

So much has changed within each of the Survey's programs, even since our 50th anniversary 25 years ago. For this special *Survey Notes* issue, each program manager contributed a brief look into how their programs have evolved and changed over the past 25 years or so. For more information about each program and their staff, please visit the "About Us" page on our website: <https://geology.utah.gov/about-us/>.

Geologic Mapping Program

by Stefan Kirby

Geologic maps were part of the earliest work produced at the UGS and have been vital to the Survey's mission throughout its history. Over the past 25 years the map making process has changed in step with the advent of digital technology, software, databases, and internet connectivity. In the late 1990s geologic maps were still created with decades-old techniques using physical aerial photographs, complicated line transfer onto paper base maps, and subsequent hard-copy review and publication of a printed product. Today our maps are created entirely in the digital realm with the aid of an innovative database structure developed by our program staff. This database structure enables a web interface that makes detailed geologic information available to all. Improvements in software and hardware including mobile tablets, web-linked data structures, and digital 3D visualization have changed the map creation process.

Although our methods have changed, the Geologic Mapping Program (GMP) continues describing Utah's amazing geologic landscapes, resources, and hazards. We have published groundbreaking maps across Utah that describe the vivid geology of southern Utah's color country, the complicated geologic landscapes of western Utah, and the extent of significant geologic hazards including the Wasatch fault and other areas important for specific energy and mineral resources.

The GMP is in the midst of its most significant change in staffing and workflow in decades. Notable recent retirements include Grant Willis, Jon King, Bob Biek, and Kent Brown, all of whom have been leaders in geologic mapping and cartography in Utah and the Nation. These positions have been filled with a new crew of early career professionals from diverse backgrounds that include mappers and GIS analysts, who are leading the way with new mapping techniques and expedited workflows. At the Utah Geological Survey's 75th anniversary the GMP is stronger than ever and ready to raise the standard of geologic mapping across Utah and the Nation.



Don Clark and Genevieve Atwood at the Tooele 30'x60' quadrangle map field review in May 2017.



Rosemary Fasselin and Subigya Shah discuss changes to GIS data and cartography to prepare the Jarvis Peak quadrangle for publication, March 2023.



Stefan Kirby describes the geology of the Vernon Hills to the Rush Valley field review group, October 2011.



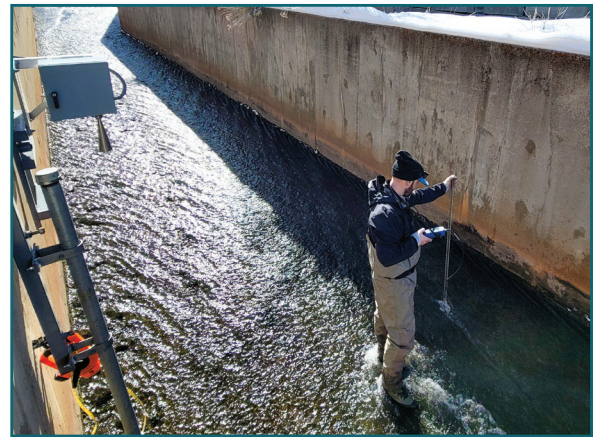
Members of the UGS mapping group examine Proterozoic-age quartzite in upper Little Cottonwood Canyon, September 2023.

Groundwater & Wetlands Program

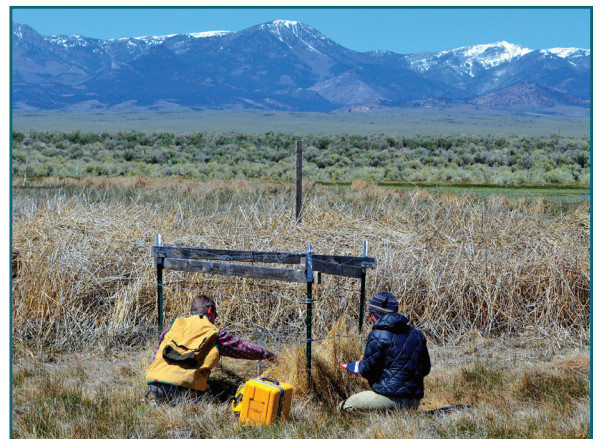
by Hugh Hurlow

Groundwater investigations at UGS were sporadic and narrowly focused until 1994, when a water section was created within the Applied Geology Program. The initial team consisted of Mike Lowe (manager), Frank Ashland, and Charlie Bishop. Frank conducted a landmark hydrogeologic study of the Snyderville Basin. In 1995, Hugh Hurlow joined the section to work on a hydrogeologic study of the St. George area, in concert with groundwater flow modeling by the U.S. Geological Survey. In 1996, Janae Wallace came aboard to log water well cuttings, then expanded her repertoire to include a variety of water quality studies primarily funded through the Utah Division of Water Quality. That same year, the section evolved into the Environmental Sciences Program with the addition of paleontology and paleoecology staff, including the dynamic Jim Kirkland as State Paleontologist. We grew steadily as our partnerships with state and federal government agencies, water conservancy districts, and local governments solidified. GIS Analyst Richard Emerson recognized the absence of a wetland program in other state agencies and the potential of U.S. Environmental Protection Agency Wetland Program Development Grants (WPDG), and secured funding to hire an ecologist to lead wetlands projects at the UGS and serve as the State Wetlands Coordinator. In 2014, Diane Menuz became manager of the wetlands section, which grew with increasing success at bringing in federal funds, focusing on wetland mapping, assessment, and remote sensing projects. In 2016 the paleontology group moved to the Geologic Mapping Program and our program was renamed the Groundwater and Wetlands Program (GWP). Meanwhile, the groundwater section expanded its expertise to include water budget analysis, hydrogeochemistry, geothermal studies, watershed monitoring, and geophysics.

Another phase of rapid change and growth began in 2018, as water issues in Utah became more serious and drought threatened all water supplies. We turned to focus on critical zone/climate science as Paul Inkenbrandt developed the Utah Flux Network to directly measure consumptive water use by crops and native vegetation including wetlands, and Hugh Hurlow began a program to evaluate the hydrologic effects of watershed restoration. The GWP added three new positions between 2020 and 2023 as funding and demand increased. Today the GWP has 18 scientists and an operating budget of \$2.3 million; both figures were unimaginable at the end of 2016 when our founding father Mike Lowe retired. Looking ahead, we have a group of excellent scientists that are great colleagues and care about their work having positive impacts on the greater community and natural environment. Our partnerships with state and federal agencies and local governments have strengthened and increased. We strive to provide the best possible data and analyses to address Utah's difficult water resource issues.



Greg Gavin takes field discharge measurements from Chalk Creek near Fillmore, Utah, February 2023.



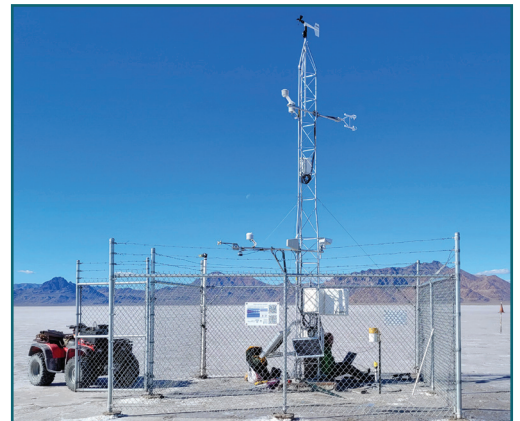
Rich Emerson and Diane Menuz download data from an automatic recording probe in a shallow wetland well on the edge of Pruess Lake in southern Snake Valley, May 2014.



Claire Spangenberg Kellner records groundwater measurements in Meadow, Utah, March 2022.



The UGS wetlands team visits the Great Salt Lake Shorelands Preserve, March 2024.



Paul Inkenbrandt takes measurements at the Flux Network "BFLAT" eddy covariance station on the Bonneville Salt Flats, October 2021.

Paleontology Section

by Don DeBlieux

The UGS paleontology section has consisted over the years of a small, yet incredibly productive team led initially by Jim Madsen, the first State Paleontologist, followed by Dave Gillette and now Jim Kirkland. Over the past two decades, Kirkland and the paleo team—Martha Hayden, Don DeBlieux, and various paid interns and volunteers—have been leading players in the paleontological renaissance that has taken place in Utah. Jim’s work on the geology, paleontology, and stratigraphy of the Cedar Mountain Formation has transformed our knowledge of these rocks and put them on the map as one of the richest dinosaur-bearing formations in the world. Our paleontology field program has been wildly successful with the discovery of thousands of vertebrate fossils and publication of dozens of scientific papers. A few highlights include the description and naming of new dinosaurs including *Falcarius utahensis*, *Diabloceratops eatoni*, *Yurgovuchia doellingi*, *Martharaptor greenriverensis*, *Iguanacolossus fortis*, *Hippodraco scutidens*, and *Mierasaurus bobyongi*. In 2014 we successfully collected a 9-ton block of *Utahraptor* fossils that was a major achievement. The paleontology team has collaborated with numerous scientists from all over the world and has mentored and trained over 100 students and volunteers during their dinosaur excavations. The team was also instrumental in the preservation of the world-class dinosaur tracksite at the St. George Dinosaur Discovery Site and the establishment of the museum there. We have also had fruitful partnerships with public land management agencies such as the National Park Service and the Bureau of Land Management to survey fossils on lands they administer. Finally, we continue to maintain the Utah Paleontological Database, the oldest of its kind in the U.S., which now boasts over 25,000 locality records. As the present team winds down their careers, they look forward to passing along their substantial knowledge of Utah paleontology to their successors so the UGS paleontology section can continue to thrive into the future.



Jim Kirkland and Gary Hunt prepare a large femur bone for plaster jacketing at Doellings Bowl in Grand County, August 2011.



Jim Kirkland and Don DeBlieux unveil the reconstructed Last Chance ceratopsian skull during Earth Science Week 2007.



Elliot Jagniecki and Andrew Rupke investigate the halite saturation state of the north arm of Great Salt Lake by sampling and testing the lake brine in 2021.



Ryan Gall teaches petroleum industry professionals about the Green River Formation during an energy industry field course in Nine Mile Canyon, September 2022.



Tom Chidsey explores megapolygons covered in halite at Promontory Point, September 2015.



Stephanie Mills describes the impact and utility of core preserved at the Utah Core Research Center in 2023.

Energy & Minerals Program

by Michael Vanden Berg

Over the past 25 years, the Energy and Minerals Program (EMP) has grown into one of the largest groups at the UGS. EMP has been very successful in applying for and receiving large grants from the federal government and other agencies to study Utah’s energy and mineral resources. Throughout the 1990s and 2000s, many of these funded projects focused on fossil fuel resources including coal, oil, natural gas, and even oil shale. In the late 2000s and early 2010s, focus shifted from researching conventional hydrocarbon reservoirs to studying resource plays (e.g., shale gas and shale/tight oil). However, priorities at the federal level shifted again in the late 2010s and into the early 2020s. Nearly every project within the EMP group currently focuses on mitigating carbon emissions, including studying geothermal resources, carbon dioxide storage reservoirs, and critical mineral resources, especially minerals related to the electrification of our modern society (e.g., lithium, copper, tellurium, indium, etc.). The EMP is well suited to pivot between these changing priorities since all types of resource evaluations are dependent on a deep understanding of Utah’s subsurface, expertise that is well established at the UGS.

Geologic Hazards Program

by Steve Bowman

The Geologic Hazards Program (GHP) has undergone significant changes in the past 25 years, especially regarding how data are collected, visualized, stored, and distributed to the public. For example, we now use high-resolution GPS equipment and lidar-equipped drones to measure and monitor the movement of landslides. Drones also make assessing an active landslide and responding to other hazard emergencies much safer. The way we conduct fault studies has also changed with technology; time-consuming manual methods have been replaced by digital elevation models, electronic survey transits, and software on computers and tablets. Hazard maps are now digitally created using geographic information systems (GIS) and are accessible through the online *Utah Geologic Hazards Portal* (<https://geology.utah.gov/apps/hazards>). The GHP's documents, maps, and photos are now digitized and available in the *UGS GeoData Archive* (<https://geodata.geology.utah.gov>). We have also digitized and archived aerial photographs of Utah, creating the *Utah Aerial Imagery Database* (<https://imagery.geology.utah.gov>), which is the largest aerial imagery database at a state level in the U.S.



Adam Hiscock describes a fault exposure at the Indiana Avenue trench site on the West Valley fault zone, August 2022.



Greg McDonald performs a GPS survey to map debris flow deposits in Little Cottonwood Canyon, November 2010.

Over the years, the GHP has developed strong collaborations with the Utah Division of Emergency Management, local governments, and federal land management agencies, as well as the academic community. In 2003, the UGS and U.S. Geological Survey established the Utah Earthquake Working Groups; 21 years later, these working groups continue to help guide earthquake research in Utah.

Advances in technology along with strong partnerships within the scientific community have allowed our program to more efficiently, accurately, and safely study and address geologic hazards in Utah.



Emily Kleber monitors landslide movement with GPS equipment at the Parkway Drive landslide in North Salt Lake, April 2016.



Structural damage to a building in downtown Magna caused by the 2020 M5.7 earthquake.

Data Management Program

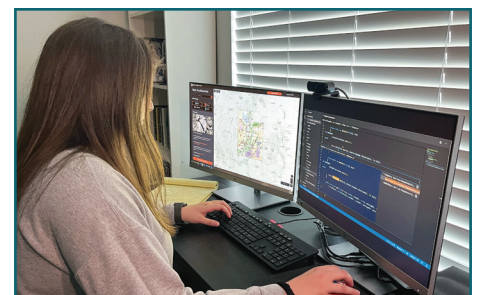
by Marshall Robinson

Formerly part of the Geologic Information and Outreach Program, the Data Management Program was created in 2021 as a natural outcome of the UGS's rapidly growing digital datasets. The UGS mission to *share* timely scientific information hinges on efficient digital data management and web development. Naturally, allocating more resources to accomplish this mission was and still is crucial to the upkeep and creation of our data-heavy online web applications which are used daily by other government agencies, researchers, teachers, and the general public.

The new program started with five staff members (Marshall Robinson, Lance Weaver, Jay Hill, Mackenzie Cope, and Martha Jensen), and has since lost one (Martha Jensen) to the Bureau of Land Management, and gained four (Nate Payne, Abby Mangum, Clinton Lunn, and Rachel Willmore). We manage the 700+ page UGS website (<https://geology.utah.gov>) and state earthquakes website (<https://earthquakes.utah.gov>) along with 30 interactive web applications spanning many disciplines of geology (<https://geology.utah.gov/maps-pubs/interactive-maps>), all of which are excellent tools for helping a wide range of audiences understand Utah's geology. Our team is dedicated to and deeply cares about ensuring the data found on the UGS website and web applications are up-to-date and easily accessible.



Jay Hill presents our various web applications at Maps on the Hill, at the Utah Capitol building, February 2020.



Mackenzie Cope works on the Utah Rockhounder Web Application that highlights where to find rocks, minerals, and fossils in Utah, May 2022.

Geologic Information & Outreach Program

by Mark Milligan

The UGS has always had a component of non-technical outreach. This can be seen in the articles and comics of old issues of *Survey Notes* and its predecessor *Quarterly Review*. A UGS "Information Section" dated back to at least 1984. But it was not until 1993 that a full-fledged program, then called the Geologic Extension Service (GES), was officially created. According to then director M. Lee Allison, the program was loosely modeled after (and the name was blatantly copied from) the Agricultural Extension Service, which was well known at the time. The primary goal of GES was (and still is for today's Geologic Information and Outreach Program) to be a one-stop source for geoscience information in Utah. The program initially included the UGS Library, and later added the Natural Resources Map & Bookstore, Editorial section, Web Services section, and technical reviewer.

One of the biggest changes to the program has been our shift from the realm of paper to the digital age. We now publish all our publications in a digital format available for free to the public on our website. Along

with digital publication came the creation of our searchable online publications database and the assignment of a unique digital object identifier (DOI) to all our publications, which allows easy reference and access on the internet. Other features available on our website include the "Ask a Geologist" service where anyone can select the link and send an email with their geology questions, and an online video library of Earth Science Week topics for teachers to use in their classrooms. We also now provide an array of geologic interest stories and information through various social media platforms.

Other notable work our program has done is to provide the geologic information for two new geologic parks: the G.K. Gilbert Geologic View Park at the mouth of Little Cottonwood Canyon in Cottonwood Heights, and the Sunrise Rotary Regional Geologic Park in the Park City area. We have also provided over 200 articles to *Survey Notes*, the triannual publication of the Survey, over the past 25 years. With our team of enthusiastic geologists, we're ready for many more years of productivity and change! 📖



GIO meeting during the beginning of the COVID-19 pandemic telework directive in 2020.



Jim Davis teaches students how to identify rocks and minerals at Earth Science Week 2019.



Jackson Smith explains the geology at Simpson Springs during the 2023 Administrative Professionals Geologic Field Trip.

The Legacy of Hellmut H. Doelling, Utah's Geology Giant

by Grant C. Willis, UGS emeritus

On November 29, 2023, Utah lost its "geology giant." Utah has had a few dozen highly notable geologists. However, in terms of contributions to geologic mapping, geologic resource information, and general understanding of Utah geology, one person towers above the others, Hellmut H. Doelling. No Utah geologist has ever contributed so much over such a long career.

Hellmut was born in New York City on July 25, 1930, and his family moved to Salt Lake City in 1943 when he was 13. He started his geology education at the University of Utah in 1948, where he did his first geologic work for the state of Utah. Harry S. Truman was president of the United States! In November 2023, thirteen presidents later, and nearly up to the day he died, he was still doing geologic mapping for the Utah Geological Survey (UGS; also refers to earlier names, Utah Geological and Mineral[ogical] Survey). During this incredible 73-year run (with interruptions for a tour of duty in the Korean War, an LDS mission, getting married, and two years as a professor at Midwestern University in Wichita Falls, Texas) he produced more geologic publications for the UGS (and many for the Utah Geological Association and other outside publishers) than anyone else ever has.



Hellmut Doelling maneuvers a truck out of the mud on a Utah Geological Association field trip, 1980.

Hellmut began his career for the UGS around 1950 when as an undergraduate he was hired to do drafting projects (today's UGS was organized in 1949 within the Utah School of Mines and Mineral Industries at the University of Utah so hiring a student to work on a project was common). He worked part time and intermittently for the UGS from 1953 to 1966, with the interruptions noted above. In 1966 Hellmut was hired to head the newly created Economic Geology Program (today's Energy and Minerals Program). In 1983, former state legislator Genevieve Atwood was appointed as State Geologist with the charge of creating a "modern" geological survey. One of her first steps was to create new geologic mapping and geologic hazards programs. She appointed Hellmut head of the Geologic Mapping Program and successfully lobbied to get three new mapping positions created (I was one of the original three; Hellmut was the only mapping boss I had in my geology career; ironically, I was his boss in his last few years with the UGS). Hellmut managed the program until 1995 when he "scaled back" to part time work as a step toward retirement (at least he was paid for part time work; we all suspected he actually worked much more than full time!). He continued part time through 2003 until, during a couple of tight budget years, he agreed to work as a volunteer, which he continued until his death. He completed over a dozen geologic maps (some 30' x 60' quadrangles) during his "retirement." At the time of his death, he had eight geologic mapping and related projects in progress!

Hellmut's UGS publication list illustrates his contributions: 6 Bulletins, 2 Circulars, 40 Map series maps, 3 Monographs containing thousands of measured sections of coal bed intervals and 123 detailed geologic maps (most hand-drawn by Hellmut; the only Monographs the UGS has ever published), 5 Miscellaneous Publications (3 with geologic maps), 71 Open-File Reports (many later became higher-level publications), 11 Reports of Investigation, 6 Special Studies, and many outside publications. For most of these he is the lead author, and in many earlier publications he was also the lead draftsman. No other UGS geologist's list is even half as long.

In his later years Hellmut often said that the thing he was most proud of was the number of young geology students and new geologists that he mentored. Nobody knows the number, but it is undoubtedly over 70—probably well over. And that doesn't count the many other people who he impacted for the better. Though he was a workaholic, Hellmut cared about and took time for people. I



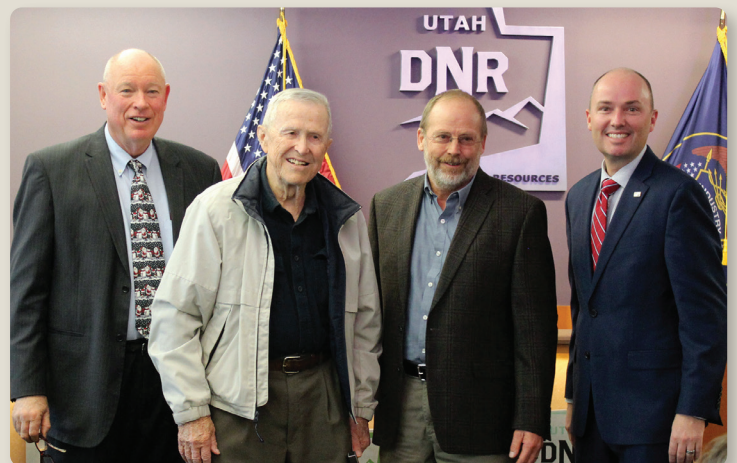
Hellmut (in white ball cap) describes the geology of the east half of the Salina quadrangle during the 2004 field review.

often saw him work with someone who was struggling, and I know of more than one case in which he was the primary instrument in completely turning someone's life around for the better.

He was an encyclopedia of Utah geology, and it was always a delight to travel around the state with him as he rattled off scientific facts or personal stories, no matter where we went. Hellmut was a notorious field geologist. He always wore old worn out, mismatched field clothes that are the antithesis of today's techno-gear. He broke most outdoor preparation rules—he never had enough safety gear to survive a freezing night, never carried true rain gear, and he almost never carried water in the field (he hated the extra weight). Instead, he would tank up on several glasses of water in the morning and rehydrate on several more in the evening. Most who worked with him assumed that sooner or later he would die on the outcrop, but he never did. Many of us secretly carried an extra bottle of water, a mylar emergency blanket, or an extra jacket just in case. But he always refused them when they were offered to him. For most of his career, he was determined to go to the field at least every other week, and he seldom broke this personal rule. He did a lot of mapping slogging through mud and snow.

In high school and at his military base he was a track star and could run a 4:21-minute mile. He put that stamina to good use in the field and would hike the legs off any field assistant. He would sometimes get frustrated with his younger, slower assistants and would send them off into some side canyon while he would power-march through the entire day. He hiked along nearly every coal seam in the state, measuring hundreds of short sections—the published Monographs still stand today as the best information on many coal deposits. During the Cold War years he mapped nearly every underground uranium mine in the state—hundreds of miles of adits and shafts.

Hellmut received several prestigious awards including the national Dibblee Award for a career devoted to geologic mapping, the Governor's Medal for Science and Technology, the UGA/UGS Hintze Award, and perhaps most cherished, a special award in 2018 for 65 years of service to the State of Utah, presented by now Governor Cox. He is a legend who stands alone, and whose contributions to Utah geology will be difficult to match. The State of Utah was fortunate to have him (it certainly got its money's worth!). All of us who had the good fortune to work beside him have been blessed by that opportunity. ■



Hellmut Doelling receives the Lifetime Service Award in 2018 for 65 years of service to the state of Utah and the UGS.

The UGS in Retrospect

by The Employees

Kimm Harty - Senior Geologist/Deputy Director, 1984–2021

When I joined the UGS, the staff included about 52 geologists and supporting staff. Ten to 15 years later, the UGS staff had reached close to 70 due to expansions through the additions of the Paleontology and Groundwater disciplines. The UGS' efforts to adequately staff these new functions was aided in part by the successful initiation of a contract and grant process whereby funds primarily from the Federal Government were matched by the State.

Rick Allis - State Geologist/Director of the UGS, 2000–2018

The dominant theme underpinning the first two decades of the 21st century for the UGS was the digital transition and widespread use of the internet for information. Digital reports, files, core images, maps, and databases in all programs were gradually added to the UGS website. Monitoring of visits to the UGS website confirmed increasing usage and resulted in Utah's geological information being more easily accessible.

For this issue of *Survey Notes*, we asked current and former long-term employees to reflect on what had changed the most during their career at the UGS and if they had a favorite memory they would like to share. Due to page limitations, we could only include a shortened and condensed excerpt from their responses. However, their full retrospectives are included in the online version of this issue at <https://geology.utah.gov/employee-retrospective>.



Rick Allis, Kimm Harty, and John Kingsley at the 2008 UGS board field trip to the Bingham Canyon mine.



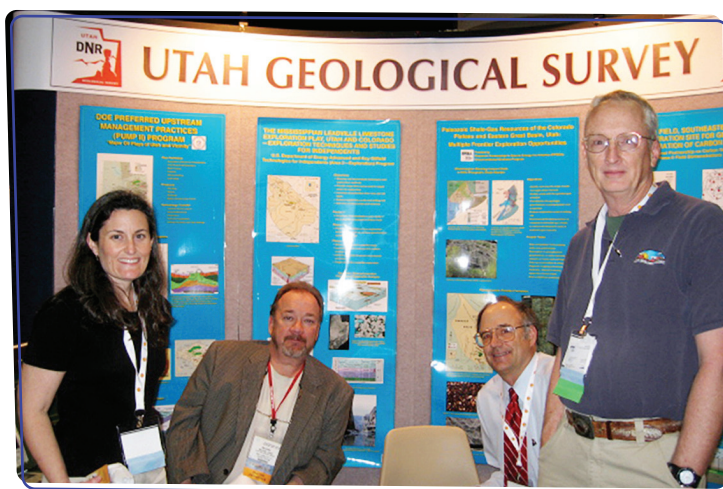
UGS geologists on the summit of Kings Peak, August 31, 2006.

Bob Biek - Senior Scientist, Geologic Mapping Program, 1996–2022

What changed the most during my tenure at the UGS? Map production techniques and the development of portable GPS. The multi-year transition from analog to digital map production involved significant changes to how mapping geologists went about creating geologic maps. I began by mapping in detail directly on stereophoto pairs and later transferring that work to a topographic base map using an analytical stereoplottor. Eventually, with the availability of statewide digital photogrammetry, lidar, and GPS, fieldwork focused on collecting data at GPS waypoints and building the map digitally in the comfort of the office. Still, to accurately interpret the geology of an area, there is no shortcut to looking at rocks and structures and landforms in the field with a fresh pair of eyes.

Craig Morgan - Senior Geologist, Energy & Minerals Program, 1989–2018

A benefit of working at the UGS was the great diversity of geological expertise I encountered. I came from a petroleum exploration background. Working in the Energy & Minerals Program, I was in daily contact with people working on coal, metals exploration, industrial minerals, and geothermal projects. Once a week, I enjoyed getting a cup of coffee and visiting all the other UGS programs. The discussions were always interesting and I learned a great deal over the years.



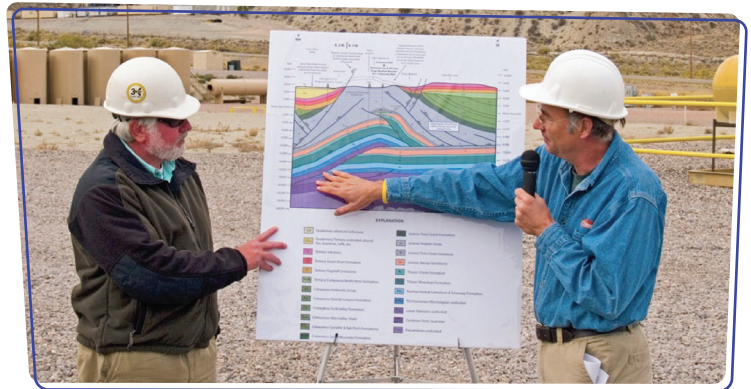
Stephanie Carney, Mike Laine, Tom Chidsey, and Craig Morgan, "man" the booth at the 2008 American Association of Petroleum Geologists annual meeting.

**Tom Chidsey - Senior Scientist,
Energy & Minerals Program, 1989–2020**

I started at the UGS in 1989 having worked for the previous 10 years for a Salt Lake City-based oil company. Shortly after my first project got started, the U.S. Department of Energy (DOE) announced a program to fund studies to prevent premature abandonment of oil wells. The UGS Director, Lee Allison, decided we would go after these DOE funding opportunities. The proposals themselves were a huge undertaking involving both the petroleum and administrative staff working at a frantic pace to prepare proposals consisting of two to as many as five large volumes. Submission of proposals in those days was not done electronically but as hard copies sent via FedEx, dropped off at the airport just under the wire. We were very successful in being awarded these grants and they became our funding bread and butter, a huge change for the UGS. Literally dozens of UGS-authored technical publications, core workshops, and field trips resulted from these grant-funded projects. The UGS's image became one of a very active state agency whose publicly available research was invaluable to the petroleum industry and beneficial to the citizens of Utah. One final note—we always included in our proposals field work to study outcrop or modern reservoir analogs. That is why I was able to raft down the Grand Canyon and snorkel in the Bahamas, and claim to be working!

**Doug Sprinkel - Senior Geologist,
Geologic Mapping Program, 1986–2019**

I saw several changes in my 34 years at the Survey. The UGS changed locations from a building in University of Utah Research Park to an office building on Foothill Drive and finally to the Department of Natural Resources (DNR) campus on North Temple. It was a little sad to leave Research Park but settling at the DNR campus was a great move for many reasons. Another big change was the creation of the Geologic Mapping Program initially led by the late Hellmut Doelling and then by Grant Willis; eventually I became a part of the Mapping Program. I believe this program changed the UGS in a positive way, and the systematic mapping of Utah has been helpful to other government agencies, industry, and the citizens of Utah.



Doug Sprinkel and Tom Chidsey at Covenant oil field during the Utah Geological Association's 2007 field trip to central Utah.



Core samples from Utah's Green River Formation fill the main hall of the Utah Core Research Center from beginning to end, October 2019.

**Tom Dempster - Assistant Curator,
Utah Core Research Center, 2000–present**

The first day on the job, the Curator of the Core Center, Carolyn Olsen, took me to the warehouse part of the building—pallets of core from front to back were waiting to be shelved. I surprised her by having it all done within two weeks. A lot of times I've had to lift some really heavy cores, but most of the time it was a joy to come to work, learn, and chat with my co-workers. When I retire, I will miss the fun, intelligent people I have known from the UGS as well as those who have come to visit us at the Utah Core Research Center where I spent most of my time. Thanks for the memories!

**Dave Tabet - Senior Scientist/Program Manager,
Energy & Minerals Program, 1992–2016**

Surprisingly for a desert state, it wasn't until 1994 that the UGS established a groundwater section, even though in the time before I arrived, the UGS had investigated numerous water issues to assist with Utah's water resource management. The 1990s and 2000s were an era of great technological change in practicing geology and disseminating geologic information. The rapid evolution in the methods and standards of digital record keeping and data display changed the way the UGS created, analyzed and presented the results of geologic investigations to its clients in academia, government, industry, and the general public. All through my career with the UGS it was a pleasure and honor to collaborate with talented, hard-working, and innovative colleagues who made the challenging work both fun and productive.

**Roger Bon - Project Geologist,
Energy & Minerals Program, 1989–2010**

My 20+ years at the Survey was a time of rapid growth and activity. I was hired to be the Industry Outreach geologist, which quickly expanded to include the technology transfer requirement of the numerous energy-related research grants the UGS was awarded. In addition, I worked with the state's mineral producers and the U.S. Geological Survey (USGS) to write an annual Mineral Activity Summary. The thing I remember most over all those years was the camaraderie I enjoyed, not only within the Energy & Minerals Program, but the entire Survey staff, USGS personnel, and the Utah mining community. It was a great experience and a happy ending to my professional career.

**Sandy Eldredge - Senior Scientist/Program Manager,
Geologic Information & Outreach Program, 1981–2014**

In the 1990s, the UGS realized that it needed to focus on disseminating its information in a non-technical format easily understood and useful to a lay-person. To carry out this effort, the UGS established the Geologic Extension Service, later renamed the Geologic Information and Outreach Program (GIO). In addition to answering public inquiries and writing non-technical publications, the GIO program worked with other UGS programs, other state agencies, educational institutions, and federal funding partners to produce publications (typically in the form of topical pamphlets, brochures, and maps) and distribute them at conferences, locally sponsored events, and classrooms. Also, a partnership with other state agencies provided a variety of services to help the public, news media, professional organizations, and teachers. Due to demand from teachers and educational institutions, the UGS then joined in a cooperative "Education Outreach Program," which has grown exponentially and has become a critical service provided by GIO. These efforts provided high-quality products and programs, which greatly facilitated information dissemination, and were a very rewarding and enjoyable part of my work at UGS.



UGS summer picnic 2022

**Kent D. Brown - Senior GIS Analyst/Photogrammetrist,
Geologic Mapping Program, 1983–2022**

When I began my career at the UGS as a cartographer, we had no computers or software to assist us. My job was creating geologic maps using skills that are archaic by today's standards. Some maps were drawn by hand on mylar film using pens and ink and with hand-lettering. For most maps we used a technique called "scribing," which was hand-engraving geologic lines on an orange-painted polyester material (Scribecoat) that served as a negative for reproducing geologic maps. By the late 1990s, we acquired computers and many generations of mapping software that completely replaced all of those old manual techniques for doing this work. Today, the GIS software we use for map creation is very powerful and sophisticated, and for me, over my 39-year career at the UGS, it was akin to living through the industrial revolution of geologic map creation!

**Hugh Hurlow - Senior Scientist/Program Manager,
Groundwater & Wetlands Program, 1995–present**

The greatest changes I've seen have come in the past five years along with a tremendous increase in emphasis on groundwater and all water resources statewide. Driven by these larger forces, the size, prominence, and emphasis of the Groundwater & Wetlands Program have changed and increased very rapidly due to increases in funding and changing technology. Along with these changes, we have added really great colleagues that are bright, intelligent, and want their job to have larger significance to positively contribute to the community.



Bill Case, Chris Wilkerson, Mark Milligan, and Sandy Eldredge receive the 2007 Crawford Award in recognition of their combined work on UGS Public Information Guide PI-87.

**Mark Milligan - Senior Scientist/Program Manager,
Geologic Information & Outreach Program, 1997–present**

When I started at the UGS in 1997 a regular part of my job was answering letters, the kind that came in a stamped envelope! I can't recall the last letter GIO received. Not even inmates send letters any longer. Another major evolution we've experienced is in the way we distribute published information to the public. When I started print was king. Now our website has amazing interactive story maps and applications. We also have a strong social media following. Looking forward we hope to reach an even larger and more diverse audience with more video content. People are exposed to information and learn in multiple different ways, and the future of Geologic Information and Outreach is bright.

**Janae Wallace - Senior Scientist,
Groundwater & Wetlands Program, 1996–present**

In my time spent at the UGS, I've watched the evolution of female geoscientists blossom. In 1995, three full-time female geologists worked at the UGS. Twenty-eight years later, the UGS staff consists of at least 25 women geoscientists. Though Genevieve Atwood led the Survey as the Director and State Geologist and Kimm Harty held steady as Deputy Director for many years, the glass ceiling breakthrough of the first female senior geologist then senior scientist at the UGS didn't happen until 2011 and 2020, respectively. I love my job and am grateful to have been part of this evolution!



Stefan Kirby, Paul Inkenbrandt, Lucy Jordan, Hugh Hurlow, Janae Wallace, and Mike Lowe receive the 2015 Crawford Award in recognition of their combined work on UGS Bulletin 135.

**Greg McDonald - Senior Geologist,
Geologic Hazards Program, 1998–present**

When asked what has changed the most since I started at UGS 26 years ago, the first thing that came to mind is how changing technology has continued to evolve and affect the way we work. My early fault studies included collecting topographic fault scarp profiles that would often involve two geologists, a pocket transit or Abney level, a measuring tape, and the better part of a day to collect a few transects. That didn't include office time needed to build a spreadsheet for plotting the data. We can now make profiles in the office using a digital elevation model in mere seconds. Gridding fault trenches with string levels and plumb bobs evolved to using electronic survey transits. We mapped trench walls by hand on paper, which required a certain artistic ability to represent the lithologic and faulting relations. We can now log on three-dimensional, georeferenced digital models made from photos taken of an entire trench. Responding to landslide emergencies used to require a boots-on-the-ground approach, where now we can use a drone to more safely assess an actively moving landslide or rockfall-producing cliff face. Technological advances have allowed us to more efficiently and safely investigate and evaluate geologic hazards.



Excavation of Iguanacolossus at the base of the Cedar Mountain Formation, southeast of Green River, Utah.

**Don DeBlieux - Assistant State Paleontologist,
Geologic Mapping & Paleontology Program, 2001–present**

I have been with the UGS for 22 years. It has been a fantastic place to work. My colleagues at the Survey are smart, talented, and passionate about what they do. For me it has been a dream job—to do paleontology in a place with one of the greatest fossil records on Earth. I have spent a few years of my UGS career camped out in the deserts of Utah looking for and digging up fossils. I have been lucky enough to work in just about every National Park and Monument in the state. Our paleontology group has collaborated with scientists from all over the world and we've done some remarkable science that has increased our understanding of Utah's geology and life on our planet in deep time. They say it's only work if you'd rather be somewhere else, so I guess I haven't worked at all!



Greg McDonald and Christopher DuRoss present evidence for a large, prehistoric earthquake on the Wasatch fault at the Santaquin trench site, summer 2005.



UGS ski day 2018



Administrative Professionals Geologic Field Trip to Ophir, Tooele County, 2015.

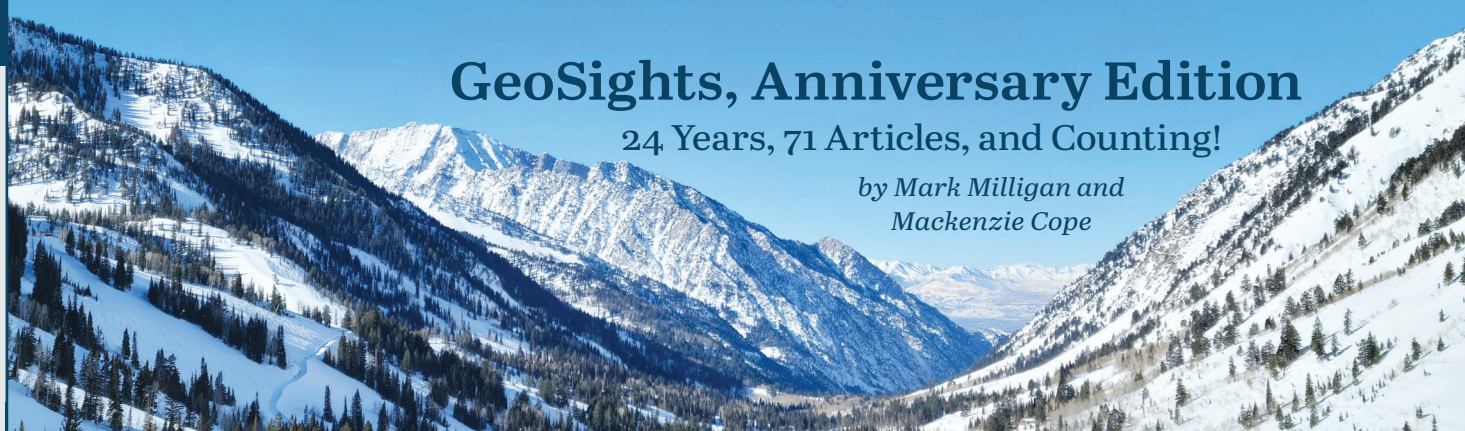
**Lori Steadman - Cartographer/GIS Analyst,
Geologic Information & Outreach Program, 1991–present**

The entrance of the digital age was the biggest change for me in the 32 years I've worked at the Survey. When I first started, we made our maps, illustrations, figures, and photos by hand. We had a darkroom that contained a processor for making negatives, a wash table, vacuum frame, exposure lamp, and a large camera. This room is where we made all our scribe coats, peels, color proofs, sticky back type, photos for publications, and most importantly, our four final negatives (black, cyan, magenta and yellow) that we sent to the printer to make the map. I enjoyed doing maps by hand. With the digital age, I've had to learn so many different versions of software, I don't know how I've kept up. Sitting in front of a computer screen made it easier but not as much fun. 📄

GeoSights, Anniversary Edition

24 Years, 71 Articles, and Counting!

by Mark Milligan and
Mackenzie Cope



Little Cottonwood Canyon's world-class U-shaped glacial valley. Photo by John Good.

Instead of a location reveal, this article recaps 24 years and 71 GeoSights articles! The first GeoSights article, "Sinkholes in Big Round Valley, Washington County," appeared in the October 2000 edition of *Survey Notes*. At that time, only 300 million people were online around the world. Google and Apple Maps were still 5 and 12 years from launch, respectively. Today over 5 billion people are online. GeoSights has evolved greatly since the original strictly print articles with turn-by-turn directions. As of 2024, GeoSights articles are now in print, online as web pages, and part of a custom web application, all with GPS coordinates. Article links are shared through UGS social media accounts on Facebook, X (Twitter), Instagram, and LinkedIn, none of which existed in 2000. Nearly 1 million people from all 50 states and 153 countries viewed GeoSights online from 2010 through 2023, the span of available data.

Why GeoSights?

GeoSights replaced RockHounder articles, which featured interesting Utah rock, mineral, and fossil collecting locations in *Survey Notes* from 1994 to 2000. The introduction of GeoSights articles was an effort to move away from only highlighting collecting sites and encourage more Utahns to get outside and view some of the many outstanding attributes that make Utah a geologic wonderland. Interestingly, the UGS continues to provide rock-hounding information in a new format through the Rockhounder web app: <https://geology.utah.gov/apps/rockhounder>.

What makes a worthy GeoSight?

Articles need to be nontechnical and appeal to a wide variety of people. We look for locations that are lesser-known geologic wonders that are open to the public, physically accessible to most Utahns (no long hikes), and geologically and geographically diverse. The top 20 articles accessed online are evenly distributed across Utah's physiographic provinces with seven in the Basin and Range, seven in the Rocky Mountains, and six in the Colorado Plateau.



Although we strive to feature sites that are not too well known, avoiding major destinations in State and National Parks that are already highly popular, we are also sensitive to disclosing locations that are relatively unknown. In our digitally connected world, relatively unknown sites, valued for being undiscovered, undisturbed, or uncrowded, are becoming exceedingly rare. Our goal with GeoSights articles is to provide good information about sites that people may have heard of or wondered how they formed and want to visit. We encourage visitors to always be respectful of the natural beauty of Utah's GeoSights and to embrace the ethic that knowledge enhances awareness and respect for the Earth.



Granitic rock weathered into bizarre shapes and forms in Devils Playground. Photo by Carl Ege.



Waterfalls, pools, and lush vegetation create a relaxing atmosphere at Cascade Springs. Photo by Christine Wilkerson.

What are the most popular GeoSights?

Based on web page visits the top 10 sites are:

1. Thistle Landslide, Utah County
2. Midway Hot Pots, Wasatch County
3. Big Rock Candy Mountain, Piute County
4. Devils Slide, Morgan County
5. Devils Playground, Box Elder County
6. Fantasy Canyon, Uintah County
7. Black Rock Desert, Millard County
8. Gandy Warm Springs, Millard County
9. Cascade Springs, Wasatch County
10. Glacial Landforms in Big and Little Cottonwood Canyons, Salt Lake County

Honorable mentions that are popular on social media but did not make the top 10 web page visits:

- Little Grand Canyon, Emery County
- Comb Ridge, San Juan County
- Notch Peak, Millard County



View from Notch Peak summit looking north. Photo by Mark Milligan.

Where can I find more information?

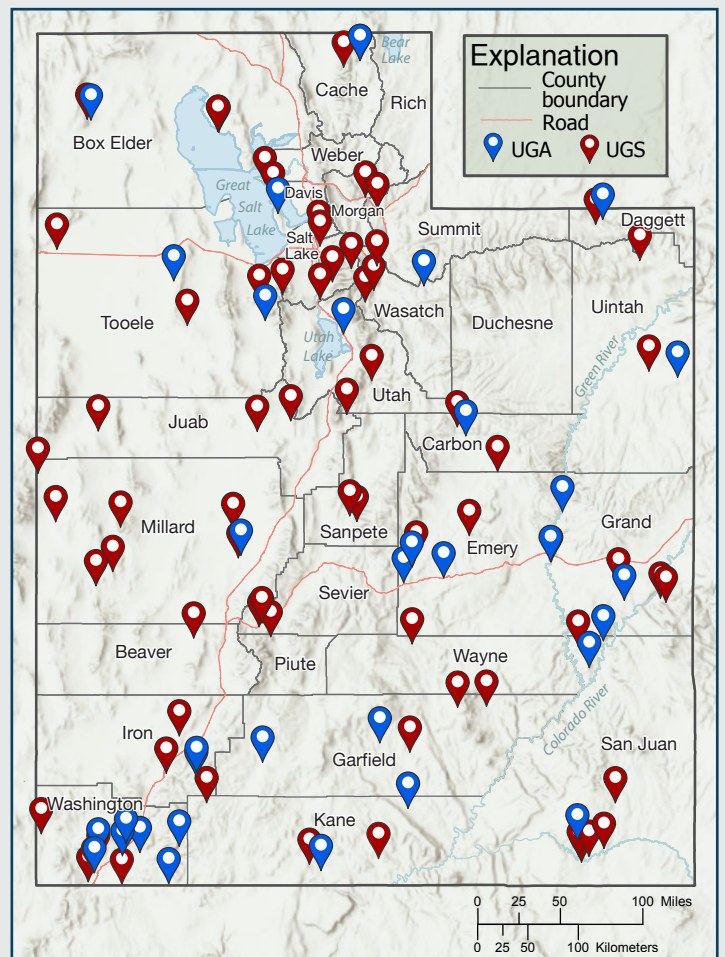
Visit the GeoSights app at <https://geology.utah.gov/apps/geosights/>. Still craving more? In collaboration with the UGS in 2019, the non-profit Utah Geological Association published *Utah Geosites*, which showcases 32 spectacular Utah geology locations, available for free through a separate web app at <https://utahgeology.org/publications/uga-geosites>. Those articles are more technical and provide a wealth of information about more amazing locations. 📖



Entrance to a lava tube at Tabernacle Hill in Black Rock Desert. Photo by Jim Davis.



The detailed fretwork of Fantasy Canyon's sandstone exhibits numerous protrusions, knobs, arches, and hollows. Photo by Jim Davis.



UGS GeoSights span Utah and include every county except Rich and Duchesne. Unfortunate omissions that will be rectified! The non-profit Utah Geological Association spotlights an additional 32 "geosites."

TEACHER'S CORNER

Earth Science Week at the UGS — Still Going Strong After 23 Years!



ESW gold panning station, 1999.

Celebrated in the second full week of October, Earth Science Week (ESW) was established in 1998 by the American Geoscience Institute to foster public appreciation and understanding of the earth sciences and to encourage stewardship of Earth. Utah and 33 other states first recognized ESW the following year and another year later the Utah Geological Survey (UGS) conducted an ESW public field trip. The UGS initiated ESW for schools in 2001 and has since welcomed nearly 15,000 elementary and middle school students from more than 80 schools across Utah. In addition, thousands of teachers, parents, and geoscience volunteers have participated. Nowadays ESW runs for two weeks and schools attend a two-hour field trip at the Utah Core Research Center where students rotate through five hands-on, interactive stations: Rocks and Minerals, the Stream Table, Paleontology, Earthquakes, and Gold Panning. For more information, including how to attend or volunteer, please visit <https://geology.utah.gov/teachers/earth-science-week/>.



ESW gold panning station, 2023.

2024 UGA Teacher of the Year

Benjamin Ray was presented the 2024 Utah Geological Association's (UGA) Utah Earth Science Teacher of the Year Award for his outstanding efforts in educating our youth on important earth science topics. Ben has been teaching for over 18 years and is currently a geology and earth science teacher of grades 10–12 at Park City High School. He also teaches other science courses—including physics, chemistry, and biology. Ben's philosophy in his high school curriculum focuses on meeting young adults where they are in their current understanding of the world and was nominated for this award by a former student who cited the impact that Ben had on their understanding and appreciation of the natural world. Congratulations Ben!



SURVEY NEWS

2024 Utah Legislative Session Events

On February 6th the UGS participated in Maps on the Hill at the Utah State Capitol to present our various web applications and current mapping projects. This event showcases the diversity of mapping resources in Utah and demonstrates how mapping technology can support decision-makers. Then on February 16th the Natural Resources Map & Bookstore helped the Division of Outdoor Recreation and other local organizations celebrate the depth, uniqueness, and innovation of the outdoor recreation industry by attending Outdoor Recreation Day on the Hill at the Capitol. The event was well attended and gave our staff the opportunity to personally interact with multiple lawmakers and their staff.



Employee News

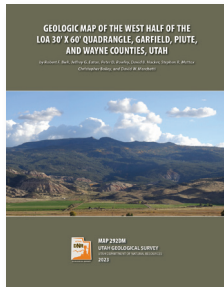
A warm welcome to **Russell Fillmore** who has accepted the position of financial manager with the UGS. Russell earned an Associate's degree from Utah Tech University, a B.S. in accounting from Utah State University, and an M.B.A. from Western Governors University. He has 21 years of service in state government with experience in accounts payable, federal grants management, and budgeting. The Data Management Program welcomes **Clinton Lunn** as a new web developer. Clinton graduated with an M.S. in geographic information sciences from Florida State University in 2018 and worked as a software developer before joining the UGS.

NEW PUBLICATIONS

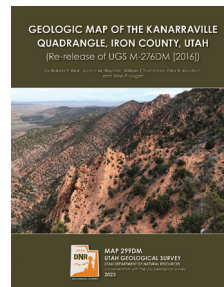
Available for download at geology.utah.gov or for purchase at utahmapstore.com.



Guide for the Preparation of Reports for the Utah Geological Survey, Fourth Edition, by Stephanie M. Carney, Michael D. Hylland, William R. Lund, and Robert Ressetar, 63 p., 6 appendices, **C-137**, <https://doi.org/10.34191/C-137>



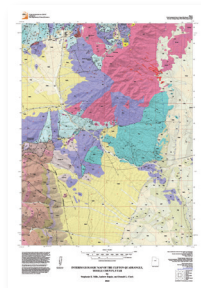
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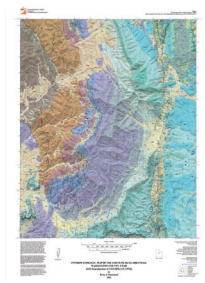
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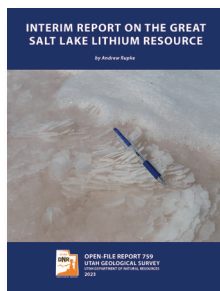
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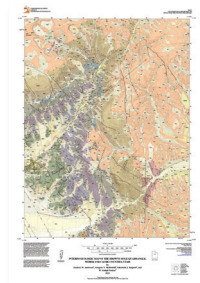
Interim Geologic Map of the Clifton Quadrangle, Tooele County, Utah, by Stephanie E. Mills, Andrew Rupke, and Donald L. Clark, 22 p., 2 plates, scale 1:24,000, **OFR-752DM**, <https://doi.org/10.34191/OFR-752DM>



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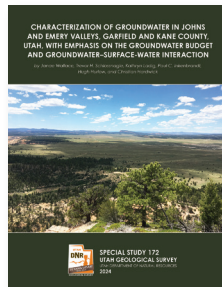
Interim Report on the Great Salt Lake Lithium Resource, by Andrew Rupke, 14 p., **OFR-759**, <https://doi.org/10.34191/OFR-759>



Interim Geologic Map of the Browns Hole Quadrangle, Weber and Cache Counties, Utah, by Zachary W. Anderson, Greg N. McDonald, Elizabeth A. Balgord, and W. Adolph Yonkee, 13 p., 2 plates, scale 1:24,000, **OFR-760**, <https://doi.org/10.34191/OFR-760>



The Changing Bonneville Salt Flats, by Jeremiah Bernau, 4 p., **PI-106**, <https://doi.org/10.34191/PI-106>



Characterization of Groundwater in Johns and Emery Valleys, Garfield and Kane County, Utah, With Emphasis on the Groundwater Budget and Groundwater-Surface-Water Interaction, by Janae Wallace, Trevor H. Schlossnagle, Kathryn Ladig, Paul C. Inkenbrandt, Hugh Hurlow, and Christian Hardwick, 76 p., 7 appendices, **SS-172**, <https://doi.org/10.34191/SS-172>

Front Cover Photos:

Top Left: Ben Erickson flies the UAV lidar system over the landslide study area at Snow Basin, August 2023.

Top Center: Spring Creek Road landslide headscarp undercutting the garage of one of the evacuated homes in Riverdale City, July 2018.

Top Right: Elliot Jagniecki prepares to take a water sample from one of four mounds formed by the mineral mirabilite on the shores of Great Salt Lake, February 2020.

Middle Left: Janae Wallace takes measurements to test water quality from a spring issuing into Twelvemile Creek in Sanpete County, 2015.

Middle Right: Stephanie Carney and Mark Milligan explain geology at the Mount Nebo Overlook during the 2018 Administrative Professionals Geologic Field Trip.

Bottom Left: Zach Anderson examines Cretaceous-Paleogene conglomerates in the upper reaches of City Creek Canyon, Salt Lake County, July 2023.

Bottom Right: The *Utahraptor* Megablock being fork-lifted into the new preparation lab at the UGS's Utah Core Research Center, February 2020.



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UGS staff at the Salt Lake office, fall 1999.





UGS staff at the Salt Lake office and Cedar City office (inset), spring 2024.

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