Alaska Division of Geological & Geophysical Surveys

ANNUAL REPORT 2024

State of Alaska
Department of Natural Resources
Alaska Division of Geological & Geophysical Surveys

CONTENTS

MISSION

Determine the potential of Alaskan land for production of metals, minerals, fuels, and geothermal resources, the locations and supplies of groundwater and construction material, and the potential geologic hazards to buildings, roads, bridges, and other installations and structures (AS 41.08.020).

COVER PHOTOS

Front. Coastal Hazards Program Manager Nora Nieminski investigates coastal erosion in Kaktovik, Alaska.

Back. Hydrology & Surficial Geology Section geologist Nick Crawford during 2024 fieldwork in Anaktuvuk Pass.

STATE OF ALASKA
Mike Dunleavy, Governor

DEPARTMENT OF NATURAL RESOURCES
John Boyle, Commissioner

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
Jennifer Athey, Acting State Geologist and Director

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MESSAGE FROM THE DIRECTOR

In 2024, the Alaska Division of Geological & Geophysical Surveys (DGGS) continued its vital work to determine the mineral and energy resource potential of Alaska lands and to support the health and safety of Alaskans through research, data collection and dissemination, and emergency response and support. From advancing public safety to supporting natural resource development, DGGS continues to provide essential knowledge to further our understanding of Alaska's unique geology.

DGGS staff conducted fieldwork statewide, released 77 geologic publications, including six geologic maps, facilitated the distribution of over 30 terabytes of digital geologic data through our website and geoportals, and hosted hundreds of visitors at the Geologic Materials Center in Anchorage. The division also hosted workshops, delivered in-person presentations, and responded to geologic hazard events, including a fatal landslide in Ketchikan and coastal flooding in western Alaska.

Ensuring the health and safety of Alaskans remains a top goal of the division. In support of this goal, volcanology staff visited 122 volcano monitoring stations and responded to volcanic unrest and eruptions at multiple volcanoes; staff from the Landslide Hazards Program traveled to Ketchikan following the fatal landslide event; Earthquake and Tsunami Hazards Program conducted 35 presentations around the state and played a critical role in the Tsunami Operations and Maritime Guidance workshops; and the geological health hazards program continued outreach to raise awareness of geological health hazards like radon gas in Alaska (517 homes were tested for radon by the program in 2024).

The division continues to evolve and expand efforts to meet the needs of Alaskans, and in 2024 established a new Geothermal Energy Program, which will focus on collecting baseline geological and geophysical data to advance understanding of Alaska's geothermal potential.

Geologic mapping programs continue in eastern Interior Alaska through the U.S. Geological Survey Earth Mapping and Resource Initiative and multiple geophysical data collection surveys were flown in support of critical mineral assessments. DGGS sections collaborated with each other, and often with other academic, state, and federal agencies on projects, like the Arctic Strategic Transportation and Resources and West Susita projects.

This is just a taste of the work division staff has completed in 2024. Please continue reading to learn more about our wide range of programs, projects, and research. I encourage you to visit our website (dggs.alaska.gov) or reach out to us if you have any questions or wish to learn more.

Melanie Werdon

Melanie Werdon
State Geologist & Director
Retired January 2025

ORGANIZATION

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Director & Chief Geologist

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- **Liz Sjoblom** — *Admin Assistant 2*
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- **Oralee Nudson** — *Systems Programmer 2*
- **Tommy Folan** — *Analyst/Programmer 3*
- **Tom Cerny** — *Microcomputer Tech 1*
- **Simone Montayne** — *Geologist 3*
- **Sue Seitz** — *Analyst/Programmer 4*
- **Ally Steinleitner** — *GIS Analyst 2*
- **Amy Macpherson** — *GIS Analyst 3*
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- **Kristen Janssen** — *Publication Spec 2*

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- **Nick Crawford** — *Geologist 1 (LTNP)*
- **Sandra Walser** — *Geologist 2*
- **Jamie Buscher** — *Geologist 4*
- **Angellica Diaz** — *College Intern*

Geologic Hazards

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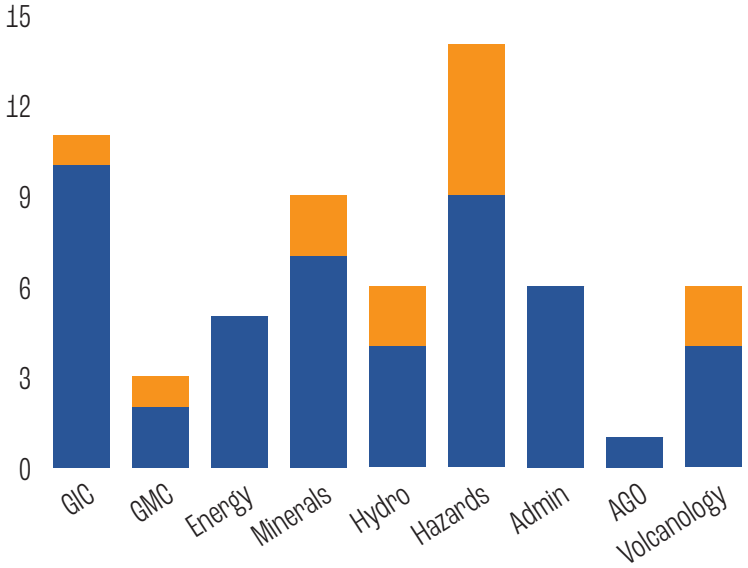
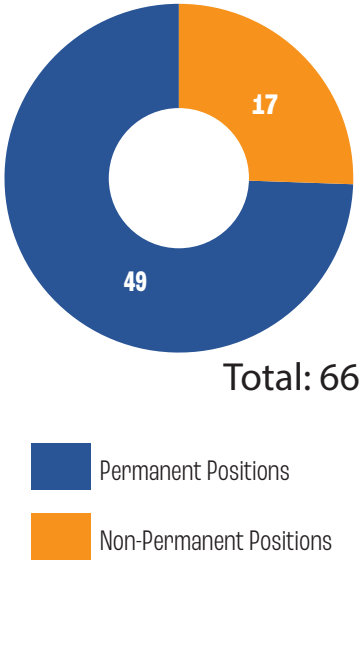
- **Jessie Christian** — *Geologist 2 (LTNP)*
- **Barrett Salisbury** — *Geologist 4*
- **Gabriel Wolken** — *Geological Scientist 1*
- **Katreen Wikstrom Jones** — *Hydrologist 3*
- **Malcolm Herstand** — *Nat Res Specialist 3*
- **Mort Larsen** — *Geologist 4*
- **Jill Nicolazzo** — *Geologist 3*
- **Conner Truskowski** — *Geologist 2 (LTNP)*
- **Paul Goodfellow** — *Env Prog Spec 4*
- **Allison Woodward** — *Nat Res Tech 2 (LTNP)*
- **James Salvador** — *Geologist 1 (LTNP)*
- **Halbe Brown** — *Geologist 1 (LTNP)*

...BY THE NUMBERS

Division Staff



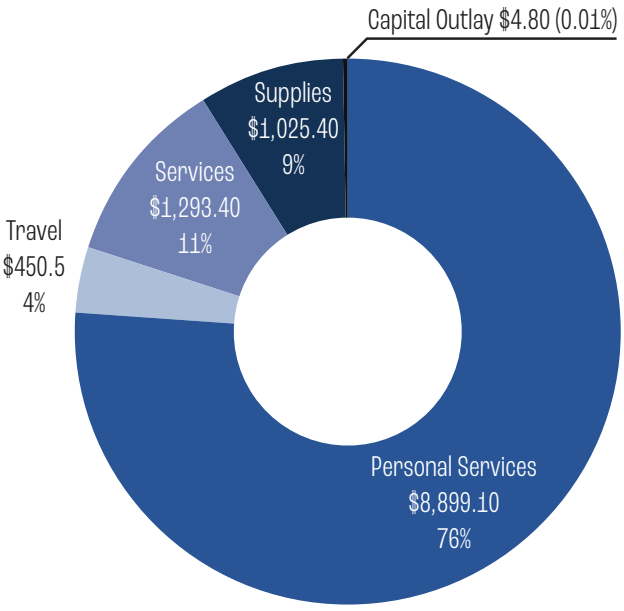


Budget

FY24 Authorized Budget

$11,673.20

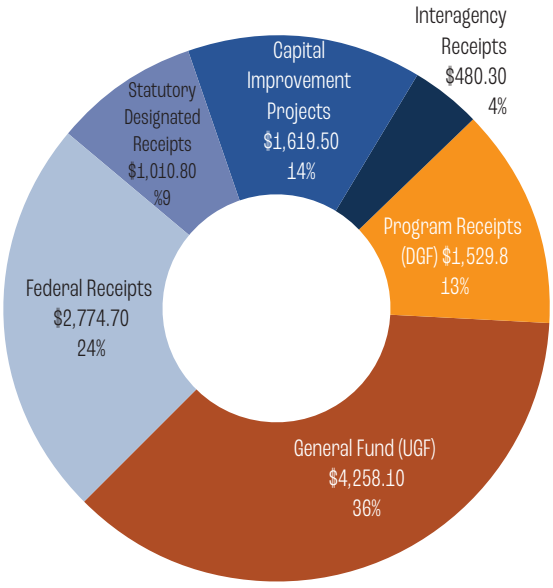
Total Budget (in thousands of dollars)



FY24 Funding Sources

$11,673.20

Total Budget (in thousands of dollars)



...BY THE NUMBERS

Geologic Mapping

Detailed geological and geophysical maps of Alaska at scales needed for resource exploration, land-use management, and geologic-hazards assessment are currently available for 22 percent of the state, but our field programs are increasing this coverage gradually each year. DGGS prioritizes the selection of new mapping areas in consultation with other state agencies, appropriate state boards and commissions, its Geologic Mapping Advisory Board, industry resource-interest groups, and other stakeholders. The survey is committed to delivering the results of its extensive field mapping programs to the public in a timely manner. In FY2024, DGGS published a combined hazard and geologic mapping total of 2,094 mi² of Alaskan lands. In calendar year 2024, DGGS published a combined 4,069 mi² of mapping. **Over the past 10 years, DGGS has published an annual average of ~3,500 mi² of peer-reviewed geologic mapping.**

2024 Geologic Maps

Surficial-geologic map of the Big Hurrah–Council–Bluff area (600 mi²)
doi.org/10.14509/31054

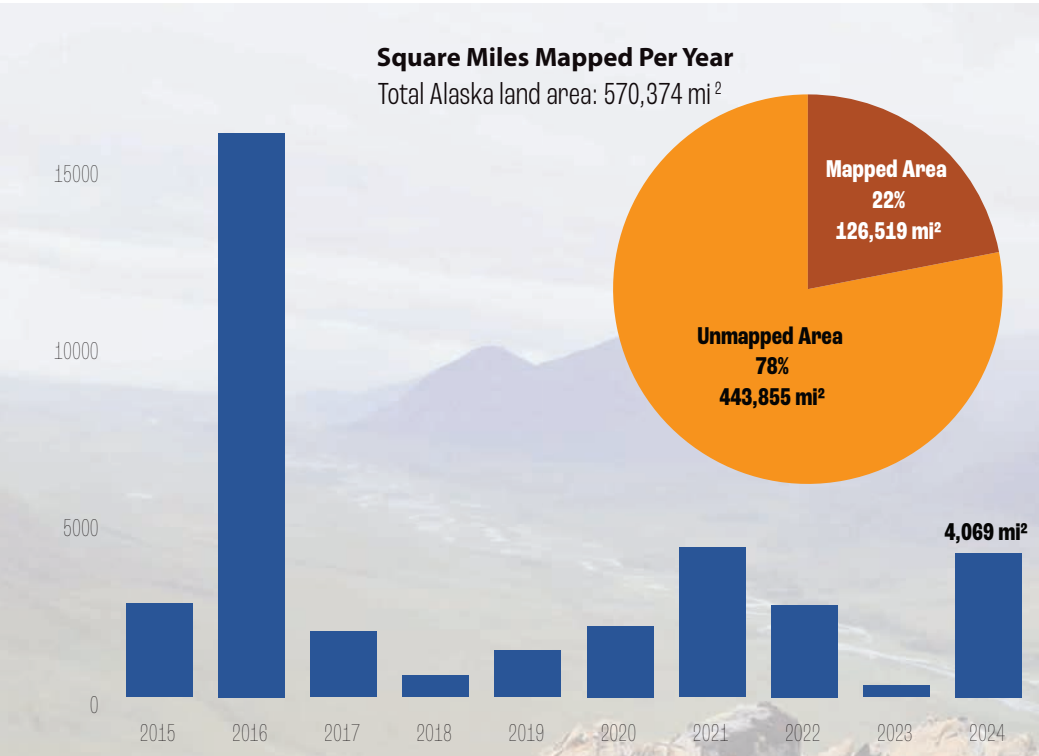
Geology and geologic hazards in the Whittier area (100 mi²)
doi.org/10.14509/31426

Surficial-geologic map of the Kivalina area (160 mi²)
doi.org/10.14509/31300

Bedrock geologic map of the Taylor Mountain area (898 mi²)
doi.org/10.14509/31168

Bedrock geologic map of the Western Tanacross area (1,716 mi²)
doi.org/10.14509/31169

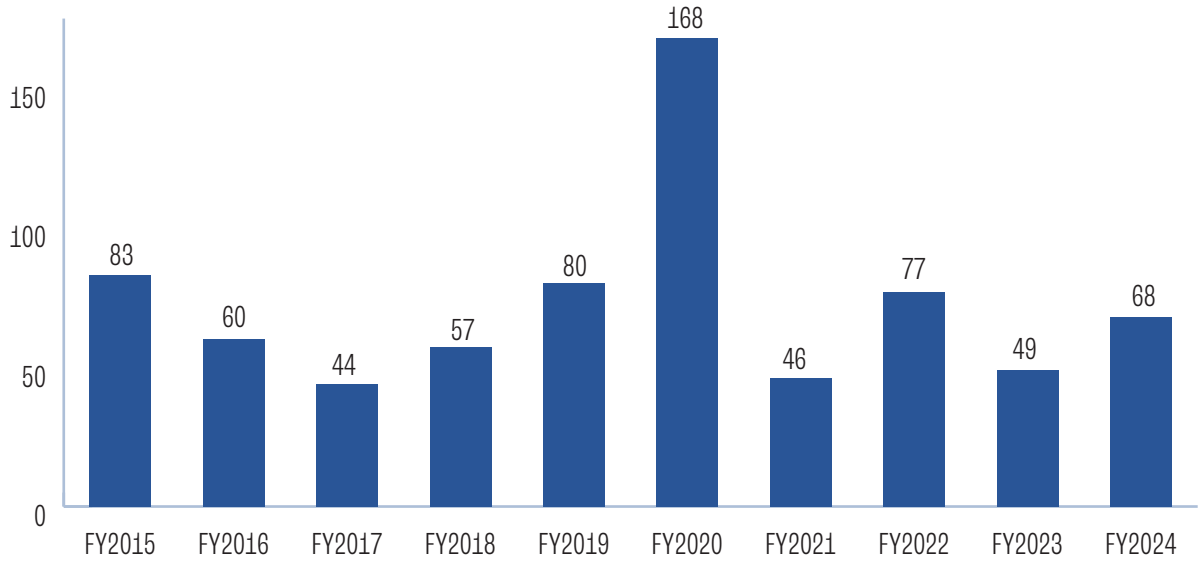
Bedrock geologic map of the Big Hurrah–Council–Bluff area (595 mi²)
doi.org/10.14509/31308



RI 2024-6 Surficial-geologic map of the Big Hurrah-Council-Bluff area.

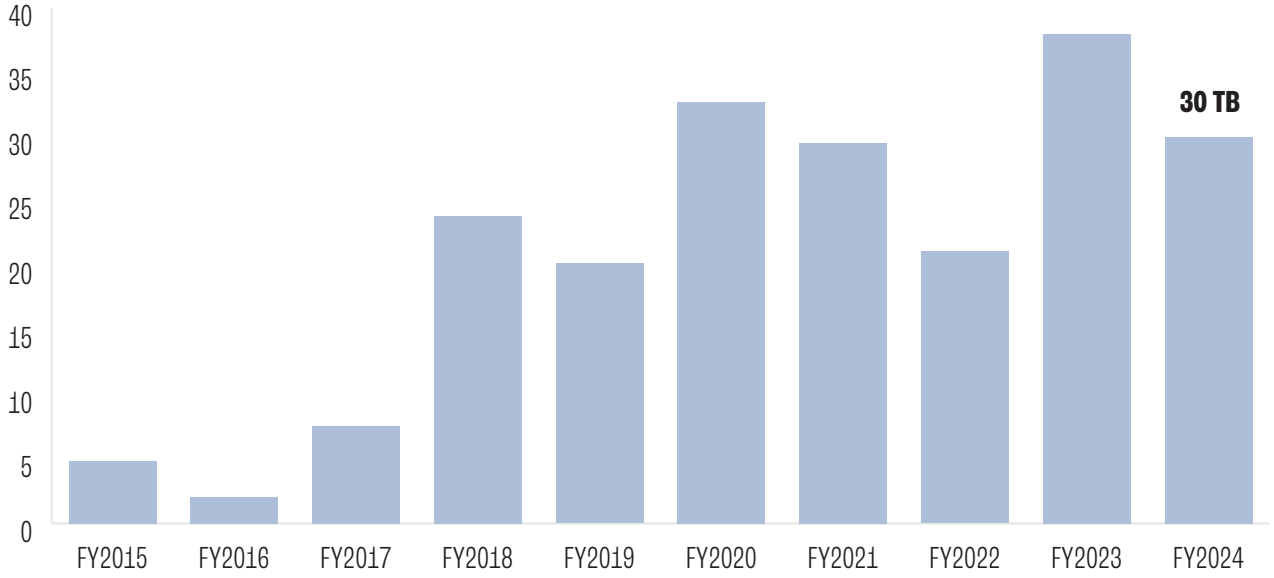
...BY THE NUMBERS

Publications*



**These numbers do not reflect the 2024 count of GeMS-compliant conversions of previously published geologic maps. For more information about these time-consuming and essential projects, see the GIC Section.*

Total Volume of Data Distributed (Terabytes)



ENERGY RESOURCES


Marwan Wartes
Section Chief


Bob Gillis


Nina Harun


Trystan Herriott


Kamil Qureshi


Josh Long

The Energy Resources Section generates new geologic information about Alaska's oil, natural gas, and coal resources and presents this information to industry, the public, and state and federal agencies through formal reports and presentations. DGGS collaborates with the Alaska Division of Oil & Gas (DOG) and other academic and government agencies to integrate outcrop and subsurface data in the analysis and interpretation of hydrocarbon systems, which has recently grown to include evaluation of Alaska's carbon sequestration and hydrogen storage potential. The group is also excited to announce the build-out of a new Geothermal Energy Program (see highlight).

FIELDWORK

The division's long-running applied energy research in northern Alaska is supported by the State of Alaska, the U.S. Geological Survey (USGS) STATEMAP program, and periodic contributions from industry. In June and July, Energy Resources geologists conducted 30 days of helicopter-supported fieldwork on the central North Slope. This field effort's primary focus was the collection of two stratigraphic test cores. This successful project was a collaborative effort with the USGS and is supported in part by the Arctic Strategic Transportation and Resources project (ASTAR)—a multi-programmatic effort to strengthen North Slope community infrastructure and access to economic opportunities and resources (see highlight).

The group also continued a multi-year geologic mapping campaign along the Philip Smith Mountains that provides a unique window into the bottom of the Colville sedimentary basin. We also conducted a variety of topical studies to evaluate petroleum systems relevant to exploration on state lands, the National Petroleum Reserve-Alaska (NPRA), and the Arctic National Wildlife Refuge (ANWR). This work included the collection of several detailed measured sections of potential Cretaceous source rock and reservoir units, including the Nanushuk Formation, which is among the most prospective onshore exploration targets in North America.

The section also conducted fieldwork in the Matanuska Valley area as part of our evaluation of the hydrocarbon potential of frontier regions of the state. Reconnaissance mapping, stratigraphic observations, and strategic sampling of Cenozoic rocks are improving our understanding of the evolution of the nearby Susitna Basin, which is prospective for oil and gas. The team also shared some of our expertise by co-leading a field seminar for colleagues at the Alaska Oil and Gas Conservation Commission (AOGCC), examining local outcrops in the region that illustrate key analogous features also present in the Cook Inlet subsurface.

CARBON AND HYDROGEN STORAGE

The section is closely monitoring the continual evolution of Alaska's energy landscape, including the growth of interest in carbon dioxide (CO_2) and hydrogen storage. The DOG and AOGCC have led efforts to erect a regulatory framework for the sequestration of captured CO_2. In partnership with DOG and the University of Alaska Fairbanks (UAF), the Energy Resources Section is participating in two projects funded by the U.S. Department of Energy (DOE) aimed at improving our understanding of southern Alaska's capability to permanently store CO_2 in deep geologic reservoirs. These initial efforts are a critical first step to build the geologic framework needed to evaluate the region's storage potential. High-quality geologic data will reduce uncertainty and attract industry to invest in major storage projects. In addition, the same geology that makes Cook Inlet a world class petroleum basin may also make it well-suited for the storage of hydrogen, a next-generation energy source. The Energy Resources Section also contributed to an inaugural workshop on hydrogen in Alaska, held at UAF. The meeting was well attended, attracting experts from around the country and illustrating the breadth of interest in exploration, production, and storage of hydrogen.

UNCONVENTIONAL CRITICAL MINERALS

DGGS co-led an effort with the University of Alaska to assess Alaska's potential to provide critical minerals, including rare-earth elements (REEs), from unconventional feedstocks such as coal. These minerals are essential components in many modern products, yet the United States lacks sufficient domestic sources, resulting in economic and national security risks due to potential major supply chain disruptions. This project is funded by the DOE and includes a diverse team of private and Native corporation partners. Phase 1 of the project was completed in late 2024 and included a final report summarizing reconnaissance screening with a specialized handheld X-Ray Fluorescence instrument capable of characterizing low-concentration REEs, such as lanthanum and cerium. More precise laser ablation inductively coupled plasma mass

A helicopter transports a drilling rig (far right distance and shown above) while a geologist looks on. Two stratigraphic test cores were collected as part of a collaborative effort for the ASTAR project on the North Slope.

spectrometry (LA-ICP-MS) geochemical analysis of samples from the Usibelli Coal Mine (a project partner) and the Ray River area demonstrate that some high-ash coals and other associated strata contain sufficient critical mineral content to warrant further study. We have submitted a proposal in collaboration with UAF to seek DOE funding for phase 2 of this program, which would enable us to continue data collection and bring together various stakeholders interested in the establishment of a critical minerals industry in Alaska.

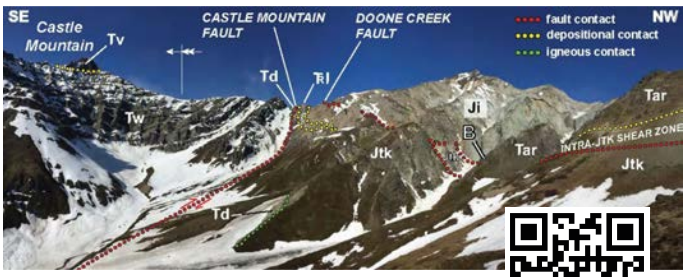
DATA DISTRIBUTION

DGGS has accumulated a vast amount of relevant petroleum-related geologic data over the past few decades and aims to release both new and legacy information in accessible formats. Important progress continues towards creating an energy resources geodatabase that will eventually allow industry and the public to search for relevant geologic data throughout the North Slope, Cook Inlet, and other Alaska frontier basins.

The Energy Resources Section has a long record of applied research that draws attention to underexplored plays, such as the section's important work on the Nanushuk Formation on the North Slope. This unit is now the host reservoir for the largest onshore conventional oil discoveries in North America in more than 30 years. Building on this, DGGS recently released an important new age for outcrops widely used as analogues for Nanushuk reservoirs (doi.org/10.14509/31152). Progress was also made on geologic maps, with two new publications from the central North Slope nearing submission. These detailed maps include a number of important outcrops of the Nanushuk Formation.

The section continued reconnaissance evaluations of non-producing frontier regions of the state. This ongoing work is in collaboration with various academic institutions working in southern Alaska and is improving understanding of the evolution of the nearby Susitna, Nenana, and Copper River basins. Results from this effort include the discovery of a significant fault in the southern Talkeetna Mountains that was summarized in a new DGGS interpretive report (doi.org/10.14509/31108). This type of work is building the framework needed to explore in areas with oil and gas potential but limited available subsurface data.

We continued our efforts to present timely, new geologic data and interpretations to a wide variety of audiences. Section staff delivered several important talks at industry and geoscience meetings highlighting Alaska's energy resource potential. Section staff also served on expert panels at town hall meetings around Alaska aimed at educating the public on carbon storage. DGGS and the USGS held a two-day public core viewing workshop at the Geologic Materials Center, sharing preliminary results from the two test cores collected as part of the ASTAR project. The event was attended by a variety of interested oil and gas companies involved in North Slope exploration and development.



Preliminary Interpretive Report 2024-1 (doi.org/10.14509/31108) investigates the newly discovered Doone Creek Fault in the Talkeetna Mountains.

DGGS'S NEW GEOTHERMAL ENERGY PROGRAM

Alaska's economic growth is hampered by high energy costs, with much of the state relying on diesel, natural gas, and coal. Diversifying energy sources in the state is important to reduce these costs. In recent years, Alaska has witnessed a notable increase in renewable energy sources like solar, wind, and hydropower. Another large potential source of energy could come from tapping geothermal heat in the subsurface. Geothermal energy has been successfully developed around the world and can provide stable baseload power with no polluting emissions.

Alaska has some of the most significant geothermal resource potential in the nation, with 97 known geothermal springs throughout the state. Despite this, only a small number of sites have witnessed advanced exploration, and just one of these—Chena Hot Springs in Interior Alaska—has been developed as a source of heat and power for local use. The poorly characterized geothermal potential of the rest of the state highlights the pressing need for new geoscience information.

In response to this need, DGGS established the Geothermal Energy Program aimed at collecting baseline geological and geophysical data to advance understanding of Alaska's geothermal potential. These data are critical for resource identification and risk reduction, both of which attract industry to invest in exploration and development and create the environment for economic growth. This program will be staffed by three new hires to be based in the Energy Resources Section; recruitment for the program manager for this effort is underway.

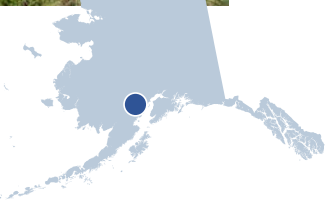
As part of the program's initial efforts to attract exploration interest in Alaska, DGGS hosted an informational booth at the annual Geothermal Rising Conference, North America's flagship meeting for industry professionals.

Augustine Volcano

SCAN to view the interactive version of this map.

Highlight

There was significant interest in Alaska's geothermal potential and the future availability of new data. The level of commercial interest is also reflected by the recent awarding of geothermal prospecting permits by the DOG for two volcanoes in Cook Inlet: Augustine Island and Mount Spurr, with the potential for additional lease sales in the near future. Initial results from industry's geophysical exploration efforts at Augustine have reportedly identified multiple low resistivity zones that may reflect shallow magma storage that could be promising targets for drilling and possible geothermal energy development.



Geologist observes outcrops of Cenozoic West Foreland Formation near Tyonek. Mount Spurr can be seen on the skyline. Geothermal prospecting permits were granted by the Division of Oil & Gas at Mount Spurr and Augustine Island.

Realizing Alaska's geothermal energy potential appears more promising than ever. Federal energy policy and recent legislation provide fiscal incentives for renewable energy projects. In addition, there have been several advances in geothermal drilling technology, particularly surrounding enhanced geothermal systems that use artificial stimulation to create reservoir permeability and porosity required for hot fluids to flow into the producing well. Combining these engineering advances with modern geological and geophysical data and interpretations will create the opportunities to provide lower-cost, clean, reliable geothermal energy and play an important role in generating a sustainable future for Alaska.

View to the south–southwest of Augustine Island (at left), with the Jurassic Naknek Formation cropping out above the far shore of Oil Bay, lower Cook Inlet.

MINERAL RESOURCES

Evan Twelker
Acting Section Chief

Wes Buchanan

Abraham Emond

Logan Fusso

Jamshid Moshrefzadeh

Travis Naibert

Rainer Newberry

Dave Szumigala

Conner Truskowski

Chris Wyatt

DGGS conducts geological mapping and geochemical and geophysical surveys to attract mineral exploration investment and support responsible development of Alaska's mineral resources. These datasets have been an important component of many successful resource exploration programs, contributing to the private-sector discovery of more than 22 million ounces of gold in the Salcha River–Pogo and Livengood areas since 2004.

DGGS participates in the USGS's Earth Mapping Resources Initiative (Earth MRI)

Mineral Resources geologist Jamshid Moshrefzadeh examines an outcrop in Interior Alaska southeast of Chena Hot Springs. This fieldwork campaign was conducted as part of the Chena–Pogo Earth MRI project.

program, a critical-minerals-focused cooperative formed to increase the nation's mineral security through geophysical surveys, geologic mapping, and geochemical analyses. This primarily federally funded project, supplemented with state matching funds, allows DGGS Mineral Resources geologists to produce and disseminate new geoscientific data types that have historically been shown to stimulate mineral industry interest and resource discovery, resulting in increased revenue to the state.

The Earth MRI program currently benefits from expanded funding through the Infrastructure Investment and Jobs Act (IIJA) bill. Alaska has received $21 million in federal funds through the program since 2019, and in calendar year 2024 DGGS received $5.2 million.

GEOPHYSICAL SURVEYING

2024 was another active year for geophysics at DGGS. The Earth MRI program continued to focus on the Kuskokwim mineral belt, a broad area of prospective geology between Manley Hot Springs, McGrath, Bethel, and Dillingham. The belt includes the Donlin Gold, Nixon Fork, and Illinois Creek deposits, and the Sleitat, Shotgun, Vinasale, Nyac, and Colorado Creek prospects, and many others. Fixed-wing aircraft surveyed the

lower topography, and a helicopter-borne system surveyed the more rugged terrain. This high-quality dataset, which we anticipate will be completed in 2025, will benefit Alaska for decades to come. The first published results are available at doi.org/10.14509/31087 and doi.org/10.14509/31094.

Mineral Resources geologist Rainer Newberry examines an outcrop southeast of Chena Hot Springs during 2024 fieldwork.

On the Seward Peninsula, DGGS is participating in a USGS mineral assessment study focused on the critical mineral graphite, a major component of electric vehicle batteries. The first stage of this assessment is an airborne electromagnetic survey of the Kigluaik, Bendeleben, and Darby mountains north and east of Nome. This survey was completed in 2024 and is available at doi.org/10.14509/31303. As part of this survey, DGGS also acquired a modern airborne electromagnetic survey over geothermal resources at Pilgrim Hot Springs.

Additionally, DGGS acquired follow-up, state-funded geophysical data over selected areas of the Earth MRI focus area, including a high-resolution magnetic survey of the REE-bearing Tofty carbonatite and a time-domain electromagnetic survey in the Kaiyuh Mountains and Illinois Creek mining district. These surveys are intended to foster mineral exploration and development in areas that include significant state land ownership.

Mineral Resources geologist Evan Twelker on traverse during 2024 Chena–Pogo gold mine fieldwork. Eleven geologists completed 380 person-days of fieldwork from June through August.

GEOLOGIC MAPPING

DGGS Mineral Resources geologists continued their multi-year Yukon-Tanana Upland geologic mapping campaign, fielding 11 geologists for 380 person-days of work in June, July, and August. This program aims to generate modern, updated, and detailed geologic maps for the mineral-rich Yukon-Tanana Upland; the work is funded by the USGS Earth MRI program and supplemented by IIJA appropriations and a State of Alaska Capital Improvement Project. Earth MRI mapping projects are funded on a three-year cycle, so that each map area receives two summers of fieldwork and one year of map production. Multiple projects run concurrently.

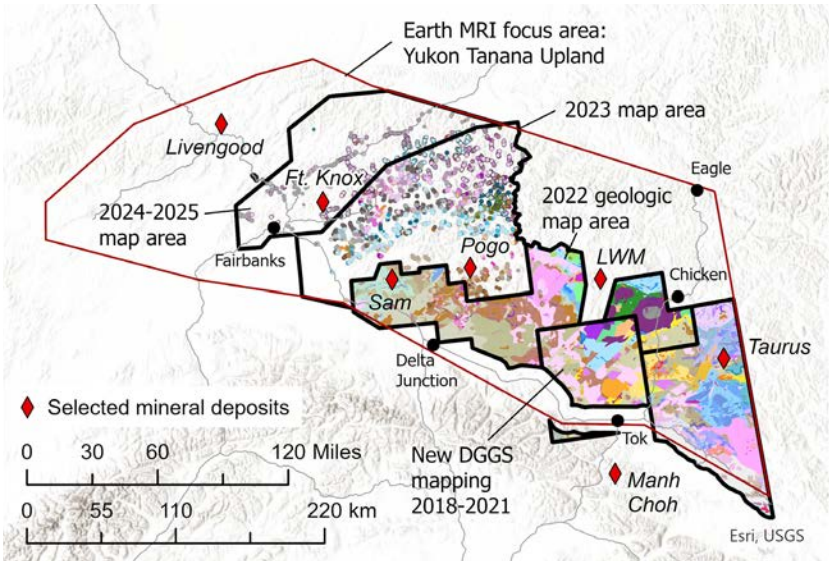
This year, geologists completed the fieldwork phase of the Chena–Pogo gold mine project,

initiated in 2023, which includes Chena Hot Springs and the Pogo gold mine. The crew began work on the Steese area geologic mapping project, which includes the Fairbanks and Circle mining districts (notable producers of gold, antimony, and tungsten) and the White Mountains (prospective for tin, tungsten, and REEs). The second phase of fieldwork will take place in 2025, followed by map publication in 2026.

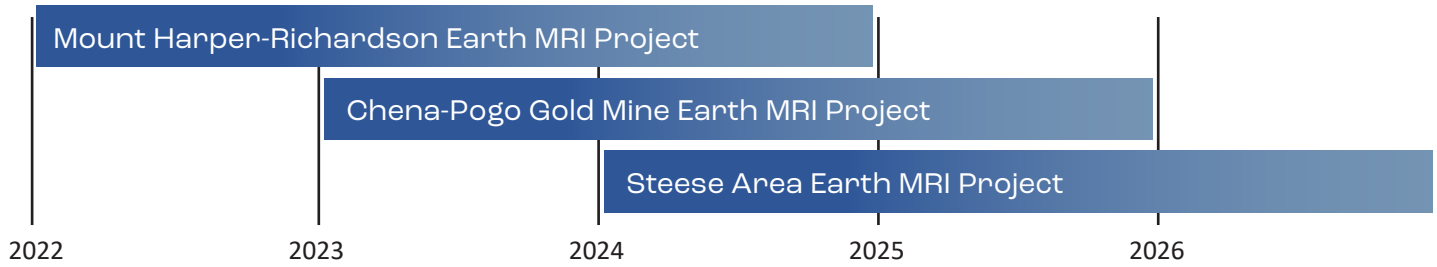
As part of the Earth MRI program, DGGS continues to collaborate with USGS on the reanalysis of archived USGS stream-sediment pulps from across the Yukon-Tanana Upland and Kuskokwim mineral belt; results include a full suite of elements using modern analytical methods. The published data are available for download through the USGS website: doi.org/10.5066/P9WHRLXH; DGGS website: maps.dggs.alaska.gov/geochem; and for viewing through the DGGS Exploration Geochemistry Web App (DGGS's most popular web app): maps.dggs.alaska.gov/geochem/.

ALASKA'S MINERAL INDUSTRY REPORT

The section's mineral resource industry expert, Dr. David Szumigala, presented updates on Alaska's mineral industry in Vancouver, Canada, and Reno, Nevada, in 2024. Dr. Szumigala published the 2021 Alaska's Mineral Industry report and is in the process of compiling the 2022 and 2023 reports. This report series provides an annual summary of activity in the mining sector and gives a consistent, factual snapshot of the exploration, development, and production of Alaska's mineral resources.



USGS-funded Earth MRI projects are typically three-year projects that run concurrently. The first two years are focused on fieldwork and compiling data. The third year focuses on map production. Recent projects focus on the mineral-rich Yukon-Tanana Upland and map adjoining study areas, working from east to west as shown in the map figure.



Highlight

Electromagnetic Surveys Show Alaska's Mineral Resources in 3D

Alaska hosts world class mineral resources, but much of the state is covered by dense forests and tundra, affectionately known to geologists as "moose pasture." To see under the vegetation, soil, and permafrost, DGGS conducts **geophysical surveys** to map unseen rock formations based on their physical properties.

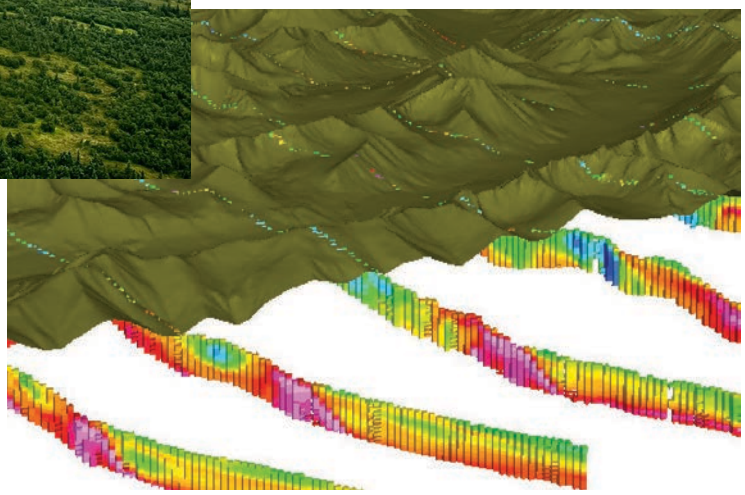
One such technology is **electromagnetic surveying**, which highlights rocks that conduct electricity. Modern time-domain electromagnetic surveys are highly sensitive and can sense conductive rocks hundreds of meters (greater than 1,000 feet) below the surface. This technology can find and map conductive mineral deposits, like the sulfide-rich ores of the Ambler District or the high-grade graphite deposits at Graphite Creek on the Seward Peninsula. It can also be used to map permafrost to inform the engineering of Alaska's critical infrastructure.

[These products are] helpful in unraveling/defining most of our major structures and defining target domains.

–Andy West, Vice President of Exploration, Western Alaska Minerals regarding the Kaiyuh Mountains 3D resistivity models

In 2024, DGGS completed the Seward Peninsula electromagnetic survey (doi.org/10.14509/31303) in partnership with the USGS and contractor SkyTEM. As part of a USGS assessment of the nation's graphite, a critical mineral used for batteries, this survey covered ~1,850 mi^2 of prospective geology north and east of Nome. The results offer an exciting new look at the geology of the area and will help focus and **decrease exploration risk for graphite** and other critical minerals (i.e., tin and REEs) in the survey area.

We are also applying this technology elsewhere in Alaska. Most recently, along with contractor SkyTEM, we **completed a survey of the Kaiyuh Mountains** mining district, host of the past-producing Illinois Creek and Perseverance mines, and an active exploration area for gold, silver, copper, and zinc. We worked with private-sector partners Western Alaska Minerals and Doyon, Limited to expand and enhance the survey, which will launch the next phase of exploration in this highly prospective district.



Above. An airborne electromagnetic data acquisition. Photo: Frederic Ladouceur, SkyTEM Canada Inc. **Right.** This figure illustrates the three-dimensional nature of the geophysical data collected.

GPR 2024-2

Seward Peninsula Electromagnetic Survey

HYDROLOGY & SURFICIAL GEOLOGY


Trent Hubbard
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Jaime Buscher


Nick Crawford


Aleena Merin Jose


Sandra Walser


Jenna Zechmann

The Hydrology & Surficial Geology Section includes programs focused on hydrology, material resources and surficial geologic mapping, and lidar (light detection and ranging) data collection and processing. Our programs enhance understanding of hydrologic processes throughout the state, identify the location and distribution of hydrologic resources, provide information about the characteristics and distribution of construction material and placer resources, and improve knowledge about geologic hazards such as landslides, active faulting, and erosion.

Many of our projects involve collaborative efforts with scientists from external organizations and other sections, including the Geologic Hazards Section. Programs like the Arctic Strategic Transportation and Resources (ASTAR) project rely on collaboration and relationships with other state and federal agencies, regional and local governments, Tribal and Indigenous organizations, academic institutions, and non-profit organizations. Data and expertise from our section provide essential baseline information for long-term planning and infrastructure development projects, which is lacking throughout much of the state.

Following the August 25, 2024, landslide in Ketchikan, DGGS collected lidar data (scan or click QR code) to help researchers and emergency response personnel study the event and prepare for the future.

MAPPING WITH LIDAR

The Hydrology & Surficial Geology Section continues to leverage the power of lidar elevation mapping in response to strategic mapping priorities across the state. Our system can collect many square miles of centimeter-accurate airborne survey information in just a few hours of flying. High-resolution elevation data, often over multiple time epochs, are essential to assess geologic hazards and interpret landscape features. Our lidar helps programs across DGGS support the division's and state's missions by providing critical data to make sound scientific decisions that benefit all Alaskans.

This year, we collected ~230 mi^2 of lidar data to support hazard assessments, avalanche studies,

and hydrologic investigations. We collected, processed, and published 11 mi^2 of lidar data near Ketchikan following the devastating landslide on August 25, 2024. This dataset was very important for quickly evaluating the landscape and helping emergency personnel make decisions in the incident's aftermath. The published dataset will be critical in helping the community with future land use planning and development decisions. Numerous stakeholders plan to use the information to evaluate the area's landscape stability.

Lidar data collection is also critically important for evaluating potentially active faults and geologic mapping activities as part of ongoing multi-program STATEMAP work north of Cook Inlet near the proposed West Susitna Access Corridor (dggs.alaska.gov/pubs/project/1685).

We also collected lidar datasets for ongoing multi-program hazard assessments—including the Barry Arm landslide—to support slope stability investigations.

In addition to collecting and processing new lidar, we continued to process and publish previously collected data. This year, we published datasets previously collected for the Portage Glacier, Maynard Mountain, Napakiak, Cordova, and Penguin Ridge areas. We also processed and published lidar data collected near Deadhorse, which will facilitate landscape change work by UAF.

HYDROLOGY

The Hydrology Program is continuing to rebuild after the tragic loss of our program manager, Ronald Daanen, and in-river program lead, Justin Germann, in a fatal helicopter crash on the North Slope that also took the lives of DGGS employee Tori Moore and pilot Tony Higdon in July 2023. In September, we hired

Radio repeater site on the North Slope. Repeaters are a critical tool in remote fieldwork that allow staff to communicate with one another.

Jamie Buscher as our Hydrology Program lead, and we are now recruiting for a hydrologist 3 to lead the in-river hydrology program. Additionally, we are recruiting for an analyst/programmer 3 to support in-river hydrology work.

Highlights from the past year include conducting fieldwork near the communities of Atqasuk, Wainwright, and Utqiagvik as part of the ASTAR project. Once the ASTAR work is complete, we hope to expand our data collection capabilities and continue long-term monitoring of weather and river systems on the North Slope.

The new hydrologist 3 will lead the effort in identifying optimal Alaska river sites to install hydroelectric units to generate maximum energy output and minimal impact and costs for local communities. Additionally, this person will work toward program goals of developing plans for an in-river (a.k.a., run-of-river) hydroelectric energy project to harness the power of river discharge to generate electricity for local communities. An Alaska in-river project was recently featured in Alaska Business (Dan Kreilkamp, August 2024) highlighting the strong government, business, and community support for the Thayer Creek Hydroelectric Project in Southeast Alaska and the

promise that these systems have for solving the future energy needs of Alaska.

The Hydrology Program also plans to expand its scope to utilize remote sensing tools to analyze hazards generated by hydrological processes. Hazards like ice jam flooding and landslides affect Alaska each year, and remote sensing tools, including Synthetic Aperture Radar and optical satellite imagery, provide insight into the role that hydrological processes play in flooding events and slope failure. We plan to pursue funding and collaboration opportunities through universities and federal agencies.

Right. Snow measurement node installed during 2024 ASTAR project fieldwork.
Below. Aerial view of bodies of water near Anaktuvuk Pass.

MATERIAL RESOURCES AND GEOLOGIC MAPPING

This year, the Surficial Geology Program continues to create maps that characterize and show the distribution of the earth's surface materials. These maps help better understand the location and characteristics of construction resource materials, geologic hazards such as faults and landslides, areas susceptible to erosion or flooding, and the impacts of climate change. They are essential when considering safety in developing or at-risk regions, the location of materials necessary for maintenance or infrastructure, or how a changing climate may impact the landscape.

In 2024, section staff worked on geologic mapping projects for areas near Haines, Kivalina, Anaktuvuk Pass (an ASTAR project), the Dalton Highway Yukon River bridge, and Skwentna (FY24 STATEMAP project on the north side of Cook Inlet near the proposed access corridor pursued by the Alaska Industrial Development and Export Authority). Community engagement continues to be an important aspect of our ASTAR project work. We had multiple community meetings with stakeholders, including Anaktuvuk Pass leadership, to solicit input and develop working relationships. Detailed descriptions of the work in both Anaktuvuk Pass and near Skwentna can be found in the ASTAR project report and the West Susitna STATEMAP highlight.

This year, we completed the final edits and published a 1:50,000-scale geologic map of the Kivalina area (161 mi^2). This map provides basic geologic information for community members and planners as they strive to adapt to a changing landscape due to erosion and climate change. Section staff also helped complete a geologic map in the Haines area (1,054 mi^2), which provides basic information about geologic materials and hazards that the community and planners can use as they move forward after the devastating 2020 landslides. It is expected to be released in early 2025.

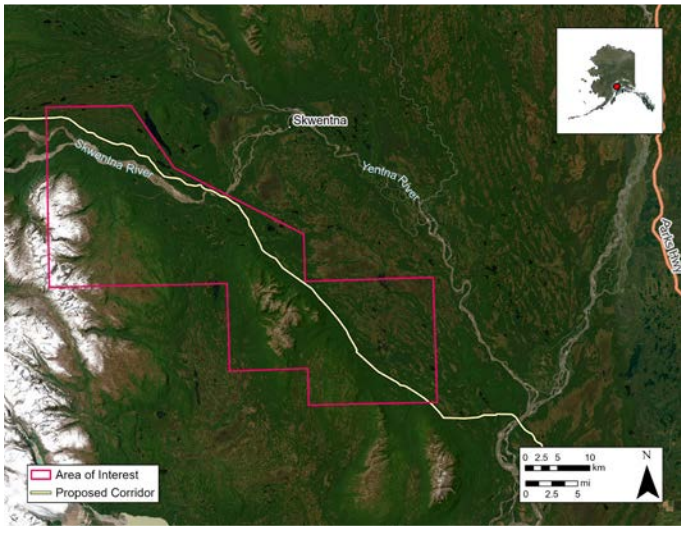
Section staff compiled data as part of geologic mapping efforts near the Yukon River bridge, a project initiated in 2016 in response to landslides observed near the bridge crossing on the Dalton Highway. Staff are compiling field notes and modifying preliminary geologic units, working toward completing a geologic map in spring 2025.

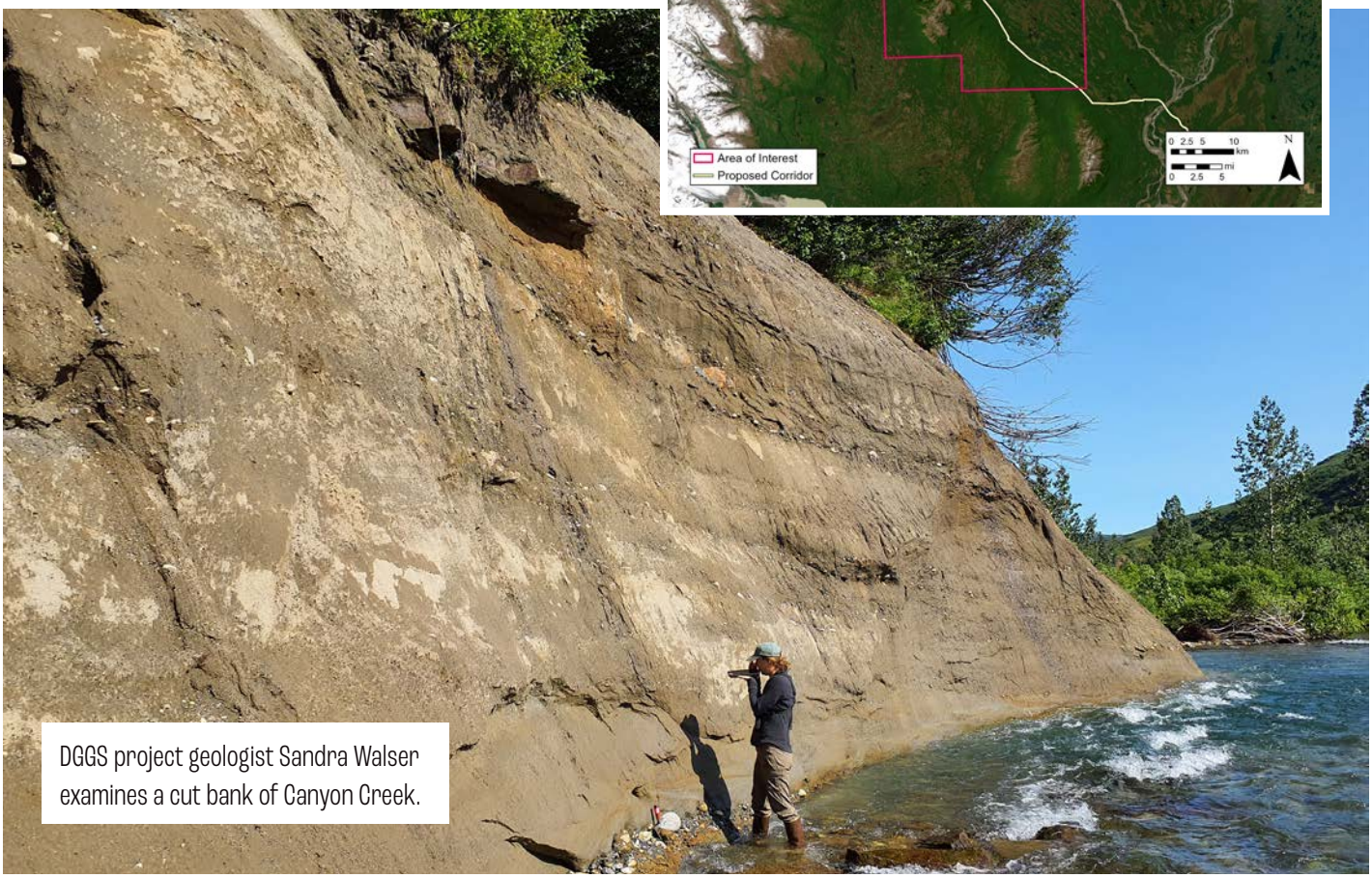
Project staff pose with samples collected near Anaktuvuk pass during ASTAR 2024 fieldwork.

West Susitna STATEMAP Project

In 2024, DGGS geologists from the Energy Resources, Geologic Hazards, and Hydrology & Surficial Geology sections conducted fieldwork and preliminary 1:50,000-scale mapping for the West Susitna STATEMAP project. The total map area covers ~500 mi^2 and includes ~50 miles of the proposed West Susitna Access Corridor that would connect Anchorage to the Happy River Valley on the western edge of the Susitna Basin. The proposed corridor aims to provide access to potential mineral, oil, and gas resources; timber harvesting; alternative energy opportunities; and recreation interests. DGGS geologists are investigating the region's Quaternary geology, hazards, and petroleum resources, providing critical baseline data to support this project. Researchers conducted 14 days of helicopter-supported fieldwork in varying terrain, from high alpine to densely vegetated wetlands. Fieldwork involved extensive aerial reconnaissance, collecting ~75 mi^2 of high-resolution lidar elevation data, and recording observations at 220 field stations, including 346 structural measurements.

Surficial geologists detailed the nature and distribution of unconsolidated Quaternary deposits to understand the potential construction material resources better and develop a more detailed glacial chronology through geologic mapping.





DGGS project geologist Sandra Walser examines a cut bank of Canyon Creek.

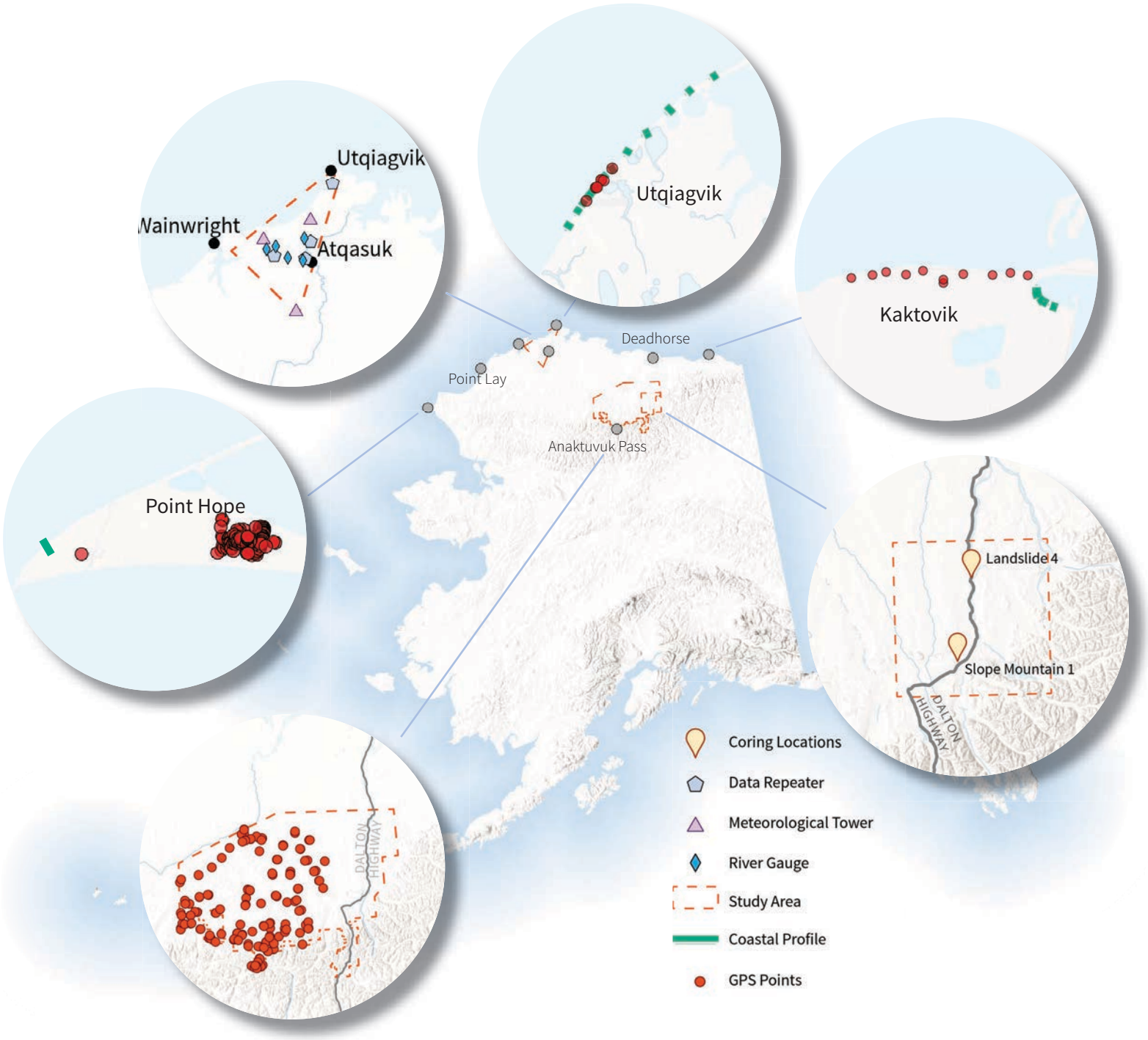
Previous mapping has been conducted at a regional scale; our more detailed work will provide critical information to help better understand geology in the field area and the Cook Inlet region as a whole while supporting a proposed plan for significant development. In conjunction with geologic mapping, understanding the engineering properties of the area's deposits will provide information about the location and characteristics of potential construction materials and geologic hazards, such as unstable slopes (landslides), erosion potential, flooding, and active faulting. This information is essential for land users, planners, and decision-makers.

The area has many geologic faults, but they have been relatively unstudied. However, fault kinematics and recency of activity bear on both potential energy resources and seismic hazards for Southcentral Alaska. In the uplands west of the Susitna Basin, satellite imagery reveals several streams that are apparently offset across miles-long bedrock lineaments, suggesting that they are relatively young faults within an area known as the Talachulitna seismic zone (TSZ). Although poorly studied, the TSZ is believed to have generated the third largest recorded shallow earthquake in Alaska (M7.0, 1943) behind the 1964 megathrust (M9.2) and 2002 Denali fault (M7.9) earthquakes. We collected new high-resolution lidar elevation data and conducted field-based surficial and bedrock mapping to better define the deformation along these faults, measuring fault and fracture surfaces along them, thereby building the first dataset of physical fault attributes in the area. Understanding whether these faults project steeply or shallowly into the subsurface contributes to the evaluation of a recently proposed model for a potential hydrocarbon play between the Susitna and Cook Inlet basins. Additionally, we performed reconnaissance-level mapping of young-appearing lineaments across the Susitna Uplands to identify recent activity and focused extensively on the surface traces of the Kahiltna River and Bulchitna Lake faults, both active structures in the young sediments of the Susitna Basin.

DGGS geologist Bob Gillis examines an outcrop of poorly consolidated sandstone that locally contains thin coal on Wolverine Creek.

Arctic Strategic Transportation and Resources (ASTAR) Project

The ASTAR project is a partnership between the Department of Natural Resources (DNR), the Department of Transportation and Public Facilities (AKDOT&PF), and the North Slope Borough (NSB) to identify, evaluate, and advance opportunities to enhance the quality of life and economic opportunities in NSB communities through infrastructure development. In 2024, the Energy Resources Section and the Coastal Hazards, Hydrology, and Sand and Gravel Resources programs continued ASTAR work.



Highlight

Sand and Gravel

The focus of the sand and gravel resources team is providing information about construction materials across the North Slope, emphasizing areas near communities where information is critical for land use planning and development decisions. In 2024, we evaluated a ~9,400 mi² area near Anaktuvuk Pass, identifying and characterizing construction materials during a 14-day field season. We collected data at 287 field sites, collected 109 samples, and loaded over 4,000 pictures into the DGGS photo database. Field data are being prepared for publication, making this information easily accessible to the public, including interested stakeholders. This summer's data and observations will inform previously completed desktop terrain unit mapping, which will subsequently help us develop and then publish construction material resource maps.

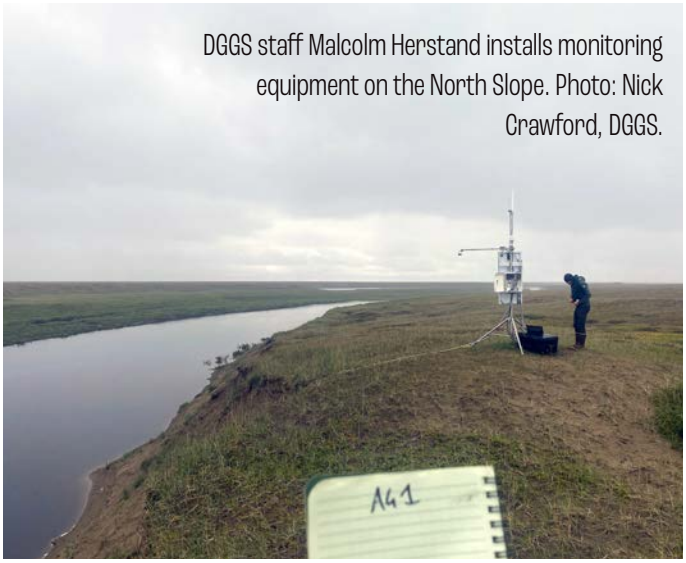
DGGS Photo Database
maps.dggs.alaska.gov/photodb

In addition to the Anaktuvuk Pass work, the program continued to compile and evaluate data from the 2019 and 2023 field seasons in the eastern and north central National Petroleum Reserve Alaska (NPRA) and near Point Lay. We also continued work on a database containing subsurface geologic information (down to ~100 ft) from drill logs and associated samples collected from over 25,000 seismic shotholes, currently housed at the Geologic Materials Center in Anchorage. Another ongoing project this year is to develop a web map and database containing information about North Slope geology publications, focusing on those with geologic hazards, surface materials, and construction resource information. Additionally, we continued our work to publish desktop terrain unit mapping and analyze data to produce and publish construction material resource maps.

ASTAR staff evaluated ~9,400 mi² near Anaktuvuk Pass over a 14-day field season in 2024.

Hydrology

Program staff conducted fieldwork in late summer 2024 near the communities of Atqasuk, Wainwright, and Utqiagvik downloading data, performing maintenance, and inventorying equipment at five stream gauging sites, three weather station sites, and four repeater locations along a proposed road connecting the communities. We anticipate expanding the ASTAR stream gauging network and making near real-time data viewing available at the established sites in 2025.



DGGS staff Malcolm Herstand installs monitoring equipment on the North Slope. Photo: Nick Crawford, DGGS.

This fall, the program staff are working to publish the hydrologic and climatological data from these stations, which are critical to supporting an environmental impact statement and the design and construction of the proposed "Triangle" road—an important objective for the NSB. This type of data is lacking on the western Arctic Coastal Plain of Alaska, and many other people, organizations, and companies, including those evaluating climate and permafrost changes on the North Slope, look forward to accessing this data.

Energy Resources

Drilling rig set up to collect core in the northern foothills of the Brooks Range.

During the 2024 summer field season on the North Slope, the Energy Resources Section, in collaboration with the USGS and the DOG, focused on completing the drilling and recovery of stratigraphic test cores from two locations along the Dalton Highway in the northern foothills of the Brooks Range.

The Slope Mountain #1 core was drilled into the Nanushuk Formation from a site located on an elevated bench on the eastern face of Slope Mountain. We recovered 560 ft of mostly fine-grained sandstone and mudstone, the latter being poorly exposed in the adjacent outcrop. Data from this core build upon previous work from the Energy Resources Section (doi.org/10.14509/2867; doi.org/10.14509/30726; dggs.alaska.gov/pubs/id/30871) focused on understanding the most prolific active oil and gas play on the North Slope in recent history.

The Landslide #4 core was drilled from a road-level site between the Dalton Highway and the Sagavanirktok River. At this location, we recovered 860 ft of mudstone and sandstone. The former includes important hydrocarbon source rocks, while the latter includes oil-stained reservoir rocks. These cores provide valuable information related to Cretaceous-aged depositional systems within the Colville Foreland Basin and have regional relevance to ongoing oil and gas exploration and carbon sequestration potential.

Coastal Flooding & Erosion

The Coastal Hazards Program's ASTAR-funded work documents flood events and ongoing erosion in addition to developing insights into the possible future impacts of emergent Arctic storm events. All ASTAR-funded data collection helps guide the development of mitigation strategies to ensure the resilience of Alaska's North Slope coastal communities.

DGGS GIS analyst KC Horen collects elevation profiles on the coastline at Point Hope.

Alaska Culvert Inventory

Scan to view

During the 2024 field season, the Coastal Hazards Program visited the communities of Point Hope and Kaktovik. In Point Hope, the field team collected first-floor elevations of critical infrastructure in the community and validated a series of culverts throughout the community and along the community's evacuation route (7-Mile Road) using the program's recently developed Alaska DGGS Culvert Inventory. Accurate knowledge of building elevations and the existence and quality of culverts (if clear or blocked) are critically valuable for making more accurate flood inundation models. To address erosion in Point Hope, the field team collected coastal elevation profiles in the same locations as previously collected by EA Engineering in July 2021, September 2022, and October 2022. The re-collected coastal elevation profiles on the north coastline of the village were used to quantify the coastline's change following a significant storm in November 2023 that washed out original cultural landmarks and meat cellars.

Coastal Hazards Program manager Nora Nieminski pilots a drone to collect coastal erosion data.

In Kaktovik, the field team re-collected coastal elevation profiles previously collected by the USGS over a decade ago along the shore of the lagoon. We also flew a drone survey along the community's western bluffs, which are crumbling away at a staggering rate. Elevations extracted from this new aerial survey will be compared against coastal elevation profiles previously collected by the USGS to quantify erosion and land loss.

GEOLOGIC HAZARDS

Nora Nieminski
Acting Section Chief

Halbe Brown

Jessie Christian

Paul Goodfellow

Malcolm Herstand

KC Horen

Mort Larsen

Jill Nicolazzo

Barrett Salisbury

James Salvador

Katreen Wikstrom Jones

Gabriel Wolken

Allison Woodward

The Geologic Hazards Section is focused on studying geologic processes that threaten lives and infrastructure. The section is composed of five unique programs that investigate and respond to coastal erosion and flooding, landslides, earthquakes and tsunamis, cryosphere changes, and mineral-related health hazards. The five programs focus on geologic hazards research and baseline data collection to support the advancement of scientific knowledge and statewide hazard mitigation. The section also manages division-wide grants that support high-value geologic data preservation projects and a statewide geologic map compilation. All programs within the Geologic Hazards Section are highly collaborative and staff work closely with the rest of the division, other state and federal agencies, regional and local governments, Tribal and Indigenous organizations, academic institutions, and non-profits.

Base station for lidar ground control surveying in the Dickason Highlands as part of the West Susitna STATEMAP project.

COASTAL HAZARDS PROGRAM

The Coastal Hazards Program (CHP) conducts field investigations in coastal communities to better understand how the coastline is changing and how it responds to hazardous events like flooding, erosion, and permafrost degradation. The CHP works closely with state, federal, Tribal, academic, public, and private institutions, and connects with community members to support geologic hazard response and resource management through scientific investigations informed by local knowledge. Through several ongoing projects, the program provides technical guidance and decision-making tools to local and state leaders working to plan for, mitigate, and adapt to hazardous conditions in the coastal zone. To this end, the CHP is developing community-specific hazard exposure assessments to augment the minimal existing data and reporting that are currently available to environmentally threatened communities.

The CHP's primary focus in 2024 was to produce flood impact assessments for at-risk communities with funding support from the National Coastal Resilience Fund in partnership with the Alaska Native Tribal Health Consortium. The publication of the detailed methodology used in the production of these reports was a major accomplishment this year. One of the project goals was to ensure the work will be reproducible and lead to more consistent risk assessments statewide. The CHP also continues to monitor erosion and helped with the installation of time-lapse cameras in Napakiak and Shaktoolik.

As part of the ASTAR project, the CHP resumed work on the North Slope, supporting communities and stakeholders by providing information about infrastructure opportunities and enhancing the region's quality of life (read more about ASTAR in the highlight). The CHP's role in the project is to address the safety needs of

Background. KC Horen and Nora Nieminski install monitoring equipment in Shaktoolik. **Inset.** Photo comparison showing the erosion following an October storm event in Shaktoolik. Photo: Gloria Andrew, Native Village of Shaktoolik.

Coastal Community Flood Assessment Project Info:
dggs.alaska.gov/pubs/project/1648

North Slope communities that are experiencing increased risks related to coastal flooding and erosion, and in 2024, fieldwork was conducted in Point Hope and Kaktovik.

At its core, the CHP's mission is to collaborate with Alaska Native communities to address their unique needs and achieve the most beneficial outcomes on a community-specific basis. In 2024, the program made significant improvements in presenting its findings to diverse audiences and inviting the public to contribute to resulting products. Specifically, the program established the Alaska Flood Observations Facebook group to encourage residents of communities impacted by flooding to share photographs of high water and deployed the Alaska DGGS Culvert Inventory, a web-based survey for residents and researchers to verify culverts (i.e., conduits for floodwaters) statewide. Finally, to simplify the flood inundation modeling methods used by the division and provide guidance for non-experts to accurately model flooding extents themselves, the CHP released a detailed methodology on still water inundation modeling with hydrological connectivity (MP 177, doi.org/10.14509/31279). Using this methodology, along with citizen scientist inputs, we are developing the Alaska Flood Inundation Tool, which allows users to view flood risk categories, past flood extents, and water level forecasts.

Scan to read MP 177

The CHP made strides to further understanding of coastal change and effectively communicate the unique hazards faced by Alaskans through the release of 17 new publications this year. Through initiatives with government, academic, private—and especially—community partners, we were able to drastically increase public engagement and facilitate the creation of user-focused products and services that will enhance planning, mitigation, and adaptation efforts statewide.

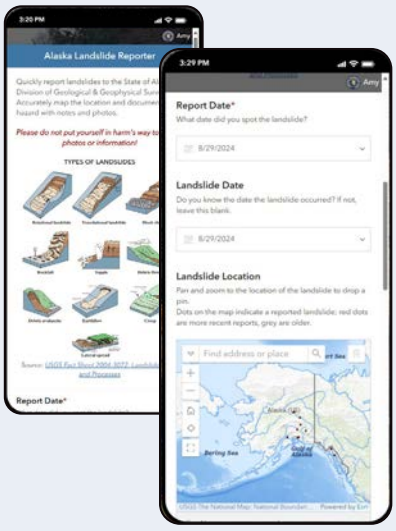
Above. KC Horen and Jessie Christian snap a picture while traveling during 2024 fieldwork. **Right.** KC Horen collects data to study beach erosion in Kaktovik.

LANDSLIDE HAZARDS PROGRAM

The Landslide Hazards Program (LHP) continues to work closely with federal and state entities, local governments and communities, and other DGGS staff on both new and ongoing projects to assess landslide hazards across the state, particularly in Prince William Sound (PWS) and Southcentral–Southeast Alaska. Funding from a USGS Cooperative Agreement has played an integral part of the Barry Arm/PWS monitoring and research program over the past few years, and has now expanded research, monitoring, and mapping capabilities in Southeast Alaska. The program continues to populate the Alaska Landslide Inventory with ongoing and previous landslide studies and plans to provide landslide information to the public through an online interactive map and data portal.

This year the LHP launched the Alaska Landslide Reporter (ALR) application. The ALR platform encourages citizen science by providing a way for members of the public to report landslide locations and information. Submissions will give geologists critical data to determine potential risk and impact while inviting contributors to play an active role in keeping Alaskans safe from the dangers of landslides before they impact lives.

Alaska Landslide Reporter App



Scan to download the Alaska Landslide Reporter app

dggs.alaska.gov/hazards/landslide-reporter.html

In 2024, the LHP received funding through the Federal Emergency Management Agency (FEMA) Cooperative Technical Partnership (CTP) Program to complete landslide hazard mapping and assessment for the City of Wrangell. After the devastating November 2023 landslide in Wrangell, the LHP has been working with the community to address the need for mapping and identify vulnerable slopes and terrain. An additional FEMA CTP was awarded for the Geologic Hazards Section to host an Alaska Geologic, Climate, and Weather Hazards Workshop. This workshop will provide a platform for scientists, engineers, emergency managers, government officials, and stakeholders at the Tribal, local, state, and federal levels to explore how we can be more prepared to respond to disastrous natural events. Our goal is to discuss agency roles, responsibilities, and capabilities before, during, and after various natural disasters to facilitate swift and effective disaster response without duplicating efforts. We will ask participants to elaborate on their agency's preparedness, past experience, specialties, and limitations to identify gaps in response capabilities and to highlight overlap for future collaborations. Establishing these roles and procedures ahead of time is critical for effective disaster response. The workshop is scheduled for March 5–7, 2025, in Anchorage.

In November 2020, Haines was impacted by extraordinary rainfall and a devastating landslide.

Following this event, through the FEMA CTP program, the LHP produced landslide inventory and landslide susceptibility maps for the Borough of Haines. These maps will support the Borough of Haines in subsequent slope stability assessments, decision-making regarding future development, and emergency response plans. LHP geologists met with Borough of Haines officials about the maps and conducted community outreach about landslide science, research, and education. The procedures and protocols established by the LHP to produce these products and engage communities will be used for future projects in other high-risk communities in the state to assist them with land management decisions and provide education on areas that may be prone to landslide activity.

The LHP participated and contributed to various workshops tailored towards landslide hazards in 2024, including the Southeast Alaska Interagency Landslide Working Group in Sitka, Prince William Sound Tsunami Hazard Guidance Workshop in Valdez, Mitigating the Hazards of Permafrost-Thaw Induced Landslides in Alaska and the Arctic in Glacier View/Matanuska Narrows, and Unstable Rock Slopes and Rock Failures Workshop in Vestland fylke, Norway. These workshops discussed the effects of a changing climate (as expressed in the cyclic advance and retreat of glaciers, degradation of permafrost, and prolonged and intense rainfall), expanding the weather station network throughout Alaska, monitoring programs and equipment, risk management, data acquisition and sharing capabilities, mapping, and collaboration opportunities.

The LHP also collaborated with the USGS and Alaska Earthquake Center (AEC) on a special topical session, Advancing Our Understanding of Landslide Hazards in Alaska, at the 2024 American Geophysical Union conference in Washington, D.C. The goal of the special session was to convene a multidisciplinary group that would highlight recent scientific advancements in our ability to understand, assess, forecast, and warn of consequential landslide hazards in Alaska.

Landslide Hazards program staff participated in and contributed to many workshops, talks, and conferences this year. **Left.** Martin Larsen visits the community of Haines for an outreach event. **Right.** DGGS staff traveled to Norway for the Unstable Rock Slopes and Rock Failures Workshop in Vestland fylke.

CLIMATE AND CRYOSPHERE HAZARDS PROGRAM

In 2024, the Climate and Cryosphere Hazards Program (CCHP) advanced its mission to assess, monitor, and predict the impacts of cryosphere changes on Alaska communities, infrastructure, and resources. Collaborating closely with the International Arctic Research Center and the Climate Adaptation Science Center at UAF, the program co-developed actionable science products aimed at enhancing state and municipal resilience to geologic hazards.

The CCHP made significant progress in snow distribution and avalanche research, conducting aerial lidar surveys in Southcentral Alaska, including the Municipality of Anchorage (MOA) and Barry Arm fjord. These efforts support avalanche and landslide hazards research. The program worked closely with the Swiss Institute for Snow and Avalanche Research to model future avalanche changes in Southeast Alaska and is now focusing on similar products for the MOA.

Glacier and permafrost hazards remained a central focus for the CCHP, with monitoring efforts targeting glacier-related slope instabilities and glacier-dammed lakes and outburst floods across the state. The program expanded its innovative approaches to geologic hazard research, utilizing a 5 MHz airborne ice-penetrating radar system to map glacier ice thickness and bed topography, providing critical data on the interplay between melting glaciers, slope stability, and infrastructure risks. At Mendenhall Glacier, the CCHP collaborated on grant proposals to improve glacier evolution models and flood prediction capabilities. The program also contributed to multi-agency initiatives to assess the Barry Arm landslide and responded to natural disasters, including landslides in Ketchikan, floods in Juneau and Valdez, and avalanches in Anchorage.

Top. This unique view shows a helicopter with an airborne ice-penetrating radar system suspended below it. This survey was conducted to map glacier ice thickness and topography for the CCHP program on Cascade Glacier, Barry Arm fjord.

Bottom. A new camera installation in cooperation with the City of Valdez at the ice-dammed lake on Valdez Glacier that is responsible for the annual outburst flood that threatens infrastructure and public safety. Photo: Malcolm Herstand, DGGS.

In 2024, the CCHP secured funding and partnerships to sustain and expand its work. A FEMA study was launched to model modern and future snow avalanches and develop hazard indication maps for Anchorage. Funding from the U.S. Bureau of Reclamation will enhance snowpack distribution modeling through lidar and community data integration, supporting the Community Snow Observations program. Additionally, the CCHP will contribute to a cooperative agreement with the USGS established to advance landslide hazard research and mapping.

Through these comprehensive efforts, the CCHP continues to deliver innovative solutions and actionable science, supporting Alaska communities in adapting to the challenges of a changing cryosphere.

EARTHQUAKE AND TSUNAMI HAZARDS PROGRAM

The Earthquake and Tsunami Hazards Program (ETHP) is focused on reducing the impact of future earthquakes and earthquake-induced geologic hazards like tsunamis and slope failures. A major component of this effort involves working directly with Alaskans (including emergency management, law enforcement, community officials, and residents) to help them become more resilient in the face of ever-present earthquake-related geologic hazards through education, planning, mitigation, and response. To this end, the ETHP conducted 35 presentations around the state in 2024, many in partnership with the Division of Homeland Security & Emergency Management (DHS&EM) and the Alaska Earthquake Center (AEC), and played a critical role in a Tsunami Operations workshop in Seward and a Maritime Guidance Workshop in Valdez.

Hazard assessment is fundamental to resilience, and the ETHP continues to assess relative seismic and tsunami hazards posed to communities, statewide infrastructure, and planned future projects. The ETHP presented original research on fault systems in Interior Alaska at the Seismological Society of America Annual Meeting as well as collected 75 mi^2 of high-resolution lidar data and

Barrett Salisbury visited a Fairbanks-area school to talk about earthquakes, landslides, and tsunamis with local students.

conducted active tectonics fieldwork as part of the West Susitna STATEMAP project. Under the National Tsunami Hazard Mitigation Program and in partnership with the AEC, DGGS published tsunami hazard reports for Anchor Point, Kenai, Ninilchik, and Tyonek in Cook Inlet and helped Unalaska renew its TsunamiReady certification in 2024.

The ETHP continues to administer the Alaska Seismic Hazards Safety Commission—a diverse panel of professionals who provide information to the public after significant earthquakes, promote public education and legislative policy to reduce the state's vulnerability to earthquakes, and amplify results of earthquake engineering resilience studies in Alaska. The ETHP manager, Barrett Salisbury, represents DNR as the current chair of the commission. The commission traveled to Juneau in March 2024 to advocate for a statewide residential building code and to recommend that critical infrastructure like schools and hospitals be prioritized for inspections to determine if structural retrofits are necessary.

Prince William Sound cruise as part of the Tsunami Hazards Guidance for Vessel Operators workshop, sponsored by the Prince William Sound Regional Citizens' Advisory Council and City of Valdez. This workshop brought together landslide and tsunami science experts, vessel operators and harbormasters, and emergency response officials to understand increasing landslide-generated tsunami risks in Alaska and to discuss agency responsibilities, current guidance for mariners, communication mechanisms, and research questions in the scientific community.

GEOLOGICAL HEALTH HAZARDS PROGRAM

The Geological Health Hazards Program (GHHP) includes the Alaska Radon and the Alaska Groundwater Quality programs, which provide vitally needed data to the public on risks to their home health and act as a bridge to join public information with actionable scientific data. More importantly, the GHHP improves the health and well-being of residents in all areas of the state and at all income levels.

Alaska Radon Program

Naturally occurring radon gas is a direct risk to the health of Alaska residents. Radon gas can concentrate in the lowest levels of buildings and may be present in many areas of the state. In 2024, approximately 21,000 lung cancer deaths were directly related to home radon exposure across the United States. The Alaska Radon Program is funded by the federal Environmental Protection Agency (EPA) through a grant from the Alaska Department of Environmental Conservation, Air Quality Division. DGGS manages the program in coordination with the UAF Cooperative Extension Service. The program provides free home testing kits to residents, along with technical information on radon mitigation resources for residents who receive high test results. In 2024, the program tested a total of 517 homes across the state, over 40 of which tested at or above the EPA's action level of 4 picocuries per liter of air of radon. Through the program's public outreach and engagement efforts, we educated, contacted, and reached 54,950 Alaskans through social media channels, news media, and interviews. Additionally, we directly spoke with over one hundred Tribal and village environmental staff at indoor air quality trainings held in the winter and spring of 2024.

Alaska Groundwater Quality Program

Several years ago, the division received funding from the EPA to develop a methodology to track groundwater quality in Alaska. The goal of this program is to provide information to state residents on their groundwater quality through an online portal which collects and maps home well-water testing results. DGGS also maintains the Be Well Informed tool, which provides homeowners with a tool to better understand results from laboratories and testing facilities. In 2025, we plan to build this out into an integrated tool, making it possible to map groundwater results as they are submitted to the agency from homeowners and communities with limited delays in data processing.

Fairbanks resident John Olson and his three-week-old baby goat stopped by the Fairbanks office in January to pick up a radon test kit as part of our Radon Action Month outreach efforts.

GEOLOGIC HAZARDS RESPONSE

The DGGS Geologic Hazards Section is not only tasked with collecting baseline data and monitoring for present-day conditions, but also for geologic hazard response. The section produces timely and reliable new information on geologic hazards in areas at risk of casualties, economic losses, and infrastructure failure from natural disasters related to earthquake and tsunami, glacial outburst flooding, environmental contaminants, coastal flooding and erosion, and landslides. There were several hazardous events that required DGGS's response in 2024.

Coastal Hazards Program Responds to Coastal Storms and Flooding Events

Alaska remains at the forefront of coastal change, which is significantly impacting Alaska Native communities in coastal and riverine environments statewide. Yet, given Alaska's unique and extreme environment, data documenting a defined understanding of present and projected risk (including current conditions and storm impacts) is limited. To help community hazard mitigation, planning, resilience, and storm forecasting, the CHP has strived to continue to fill major data gaps for communities facing flood, erosion, and permafrost threats. In 2024, the CHP strengthened its collaboration with the National Weather Service (NWS) and the USGS to better serve Alaska Native communities. Specifically, the CHP developed tools to better collect data in response to hazardous storm events. Namely, the CHP established the Alaska Flood Observations Facebook group to encourage residents of communities impacted by flooding to share photographs of high water during and throughout storm and/or high tide events. This documentation is not only included in the division's storm database but has also proven crucial to the NWS for storm forecasting and to the USGS for their forward-looking hydrodynamic modeling. There were two significant storm events in 2024 that the CHP responded to remotely by relying on close ties with individual community members and citizen scientists who shared status updates while the disaster hit. Additionally, the CHP maintains several water-level sensors that monitor community-specific water levels during the open water season.

August 16–18, 2024—Communities along the Kuskokwim Delta and the Kuskokwim River experienced high winds, heavy rain, and flooding. High-water levels on the Kuskokwim River were exacerbated by the combination of strong south–southwesterly winds pushing water (surge) up the Kuskokwim River and higher-than-normal tides.

October 20–23, 2024—Many communities experienced coastal flooding impacts similar to, or even more extreme than, those experienced during Typhoon Merbok in fall 2022. During this storm, water levels rose from 3 to 10 feet above the normal high tide line, not including wave run-up. Governor Dunleavy declared a State Disaster emergency in response to this October west coast storm. The most damaging storm surge occurred in the southern Chukchi Sea, including Kotzebue Sound.

Flooding in Kotzebue following the late October 2024 storm.

Landslide Hazards Program Responds to Slope Instabilities

Landslide susceptibility mapping and slope stability analyses can provide information to decision-makers and planners who can use these data to implement guidelines and directions for local planning and development. The Landslide Hazards Program (LHP) is currently working with several Alaska communities to prepare and publish landslide inventory maps and susceptibility studies to assist planners with evaluation of site conditions and to determine if additional investigations and mitigation measures are needed to address the identified landslide hazards and reduce risk. In support of this work, the LHP responded to multiple events.

Wrangell November 20, 2023—Zimovia Highway landslide

The November 20, 2023, Wrangell landslide. DGGS is currently working on producing a landslide assessment for the community.

On November 20, 2023, two large rain-induced landslides occurred in Wrangell. The first recorded landslide resulted in six fatalities, one survivor, and three homes destroyed. The event also cut off residents south of the landslide from Wrangell. The second landslide occurred on Middle Ridge Road, crossed the switchback forestry road in three places, and stranded one person between the two upper crossings. DGGS geologists conducted a field visit to Wrangell in the days after the event to assist with slope-stability assessments. DGGS staff collected aerial lidar data over the two landslides and have now completed a post-landslide elevation change detection report from multi-temporal lidar surveys. In support of the City and Borough of Wrangell, the LHP received funding from FEMA to complete landslide hazard and landslide susceptibility mapping and assessments. This is a two-year project that will be completed by September 2026.

Ketchikan August 27, 2024—Third Avenue Bypass and Copper Ridge Landslides

On August 27, 2024, a landslide occurred on Third Avenue Bypass in Ketchikan that resulted in one fatality, multiple injuries, two hospitalizations, damaged property, three destroyed homes, and cut off road access. Another landslide occurred on Copper Ridge that caused some property damage. A DGGS geologist traveled to the site to meet other responding agencies (Ketchikan Fire Department, Ketchikan Gateway Borough, AKDOT&PF, DHS&EM, Tongass National Forest Service, and NWS) to assess the situation, discuss site conditions, and evaluate the stability of the slopes. Governor Dunleavy issued a State Disaster Declaration and on November 14, 2024, President Biden approved a Major Disaster Declaration for Alaska. Currently, there are conversations with city officials regarding funding opportunities to conduct landslide hazard mapping and assessment for the Ketchikan Borough.

Officials, including Senator Lisa Murkowski, visit the site of the August 27 landslide in Ketchikan. Photo: Michelle Kubalack. **Inset.** Aerial view of the landslide. Photo: Lance Kramer.

VOLCANOLOGY

From left to right: Lee Zirnheld, Scott Crass, Abbey Nastan, Cheryl Cameron (Section Chief), and Dain Harmon.

The Volcanology Section is part of the multi-agency Alaska Volcano Observatory (AVO). AVO's primary objectives are to provide timely and accurate warning of volcanic activity in Alaska, assess volcanic hazards, and conduct scientific investigations to understand the timing, likelihood, and processes leading to volcanic eruptions and associated hazards. Alaska has more than 50 volcanoes with recent activity, and about 80 percent of the active volcanoes in the United States. The primary hazard from erupting Alaska volcanoes is volcanic ash, particularly from ashfall on communities and ash in the atmosphere disrupting aviation. AVO utilizes knowledge of particular volcanic systems, combined with operational monitoring that includes satellite remote sensing, seismology, infrasound, gas emissions, and ground deformation, to assess risk and provide warning of volcanic eruptions and hazards.

2024 AVO FIELD OPERATIONS

During this field season, field personnel from all three AVO partner agencies (DGGS, along with USGS and UAF Geophysical Institute) visited 122 volcano monitoring stations across Alaska, stretching from volcanoes in the far western Aleutian Islands to Mount Edgecumbe in Southeast Alaska. Our monitoring sites are very remote and are generally accessed via helicopter. The Volcanology Section contracted three helicopter vendors who flew a total of 105 of the 130 scheduled days. This year, we also conducted some work via boat–our field crews caught a ride out to the far western Aleutian Islands with the U.S. Fish & Wildlife Service research vessel *Tiĝlax̂*. They then had to do some strenuous hiking to conduct volcano monitoring station maintenance for our networks on Semisopochnoi, Little Sitkin, and Gareloi. All of

DGGS/AVO geologist Abbey Nastan during 2024 fieldwork at Mount Edgecumbe. In 2024, Volcanology Section staff flew 105 days of helicopter-supported fieldwork.

this hard work completed by our field crews has yielded fantastic results: high-quality data, a more resilient network, and now AVO officially monitors 35 volcanoes with local ground instrumentation–the highest number ever reached.

2024 fieldwork also included a geologic study at the mud volcanoes on the flank of Mount Drum, near Glennallen, where new thermal springs were observed; ongoing mapping at Shishaldin to document and understand the 2023 eruption; volcano hazard studies and community engagement at Makushin; and further work to determine the youngest eruptive deposit's age and character at Mount Edgecumbe.

2024 VOLCANIC ACTIVITY YEAR-IN-REVIEW

In 2024, Volcanology Section staff responded to volcanic eruptions at Great Sitkin and Atka volcanic complex, the tail end of the 2023 eruption at Shishaldin Volcano, and significant unrest or other events at Spurr, Trident, Gareloi, Kanaga, and Cleveland volcanoes, as well as many resuspended ash events in the Katmai area.

During unrest and eruptions, Volcanology Section personnel work with AVO partners on numerous response duties, including:

- Issuing volcanic eruption alerts in collaboration with USGS and UAF colleagues.
- Monitoring satellite and seismic data streams 24/7.
- Keeping detailed records of eruption chronologies, impacts, and response activities.
- Conducting outreach to engage citizen scientists.
- Maintaining current information on public and internal websites, Facebook, X, and Instagram.

Aerial photo of Great Sitkin Volcano from the north. Some steam is visible on the active part of the lava dome, which is snow free. Photo: Steven Skeehan.

2024 VOLCANO ACTIVITY HIGHLIGHTS

Great Sitkin 2021–2024 Eruption

In 2024, Great Sitkin Volcano (in the central Aleutians) continued its slow and steady eruption of lava. This eruption began in 2021, and the alert levels remained at ORANGE/WATCH throughout 2024. AVO scientists continue to monitor the extent of the lava flow within the summit crater, mostly using satellite radar data.

Atka Volcanic Complex 2024 Eruption

Korovin Volcano, part of the Atka volcanic complex in the central Aleutians, experienced a brief phreatic (steam-driven) explosion on March 27, 2024. No ash deposits or other surface changes were seen after the explosion. In response, AVO raised the alert levels to YELLOW/ADVISORY. Seismic activity dropped off quickly after this event, and the alert levels were returned to GREEN/NORMAL on April 9.

Above. The northeast flank of Shishaldin Volcano. Pyroclastic flow deposit fans from the 2023 eruption form light-colored outcrops at the center bottom of image. Photo: M. Loewen, AVO/USGS, July 30, 2024. **Inset.** AVO geologist Pavel Izbekov examining a large lava block on the surface of proximal pyroclastic flow deposits on the northeast flank of Shishaldin. Photo: Matt Loewen, AVO/USGS, July 30, 2024.

Shishaldin 2023–2024 Eruption

Shishaldin Volcano, in the eastern Aleutians, had a significant eruption in 2023 with 13 explosive events in total, the last occurring on November 3, 2023.

In 2024, Shishaldin spent New Year's Day at ORANGE/WATCH but was lowered to YELLOW/ADVISORY the next day. The volcano exhibited typical post-eruption unrest, including frequent small earthquakes, a vigorous steam and gas plume, and occasional volcanic tremors and tiny explosions, too small to eject any material out of the vent. Apart from six days spent at ORANGE/WATCH in February when fresh ash was seen on the snow, this activity declined gradually, with the alert level lowered to GREEN/NORMAL on August 30, 2024.

Kanaga Unrest

Kanaga Volcano, in the central Aleutians, experienced a phreatic (steam-driven) explosion on December 18, 2023. At the beginning of 2024 the alert levels remained at YELLOW/ADVISORY due to ongoing seismic activity, but as this decreased to background levels, the alert levels were lowered to GREEN/NORMAL on February 27.

Gareloi Unrest

In February 2024, there was an earthquake swarm at Mount Gareloi in the western Aleutians, which prompted AVO to raise the alert levels to YELLOW/ADVISORY on February 12. High levels of seismicity continued for a few weeks but then declined, and the alert levels were lowered to GREEN/NORMAL on March 5. No other signs of unrest were detected during this period.

Cleveland Unrest

In July 2024, the very active Mount Cleveland in the central Aleutians experienced higher-than-usual rates of sulfur dioxide gas emissions and detections of high surface temperatures, which prompted AVO to raise the alert levels to YELLOW/ADVISORY on July 5. However, this activity declined to Cleveland's usual level of activity quickly, and the alert levels were lowered to GREEN/NORMAL on July 8.

Mount Edgecumbe moved from UNASSIGNED to GREEN/NORMAL for the first time on February 26, 2024.

Alert levels raised to YELLOW/ADVISORY at **Korovin volcano** on March 27, part of the Atka volcanic complex; levels were lowered to GREEN/NORMAL on April 9.

Apart from six days spent at ORANGE/WATCH in February when fresh ash was seen on the snow, **Shishaldin** spent most of the first half of 2024 at YELLOW/ADVISORY, and was eventually lowered to GREEN/NORMAL on August 30, 2024.

2024

2025

Kanaga Unrest
Alert levels lowered to GREEN/NORMAL on February 27 following a phreatic explosion in December, 2023.

Gareloi Unrest
Alert levels raised to YELLOW/ADVISORY on February 12; alert levels were lowered to GREEN/NORMAL on March 5.

The very active **Mount Cleveland** experienced higher-than-usual rates of sulfur dioxide gas emissions and detections of high surface temperatures. The alert levels were raised to YELLOW/ADVISORY on July 5, but quickly lowered to GREEN/NORMAL on July 8.

AVO raises **Mount Spurr** alert levels to YELLOW/ADVISORY on October 16, 2024.

Spurr Unrest

Mount Spurr, one of Alaska's Cook Inlet volcanoes, experienced a gradual increase in earthquake activity and ground deformation beginning in March 2024. Additionally, a new, small crater lake formed at the summit of Mount Spurr sometime between May and June—the first time that a lake has been present since the 2004–2006 period of unrest. Typical earthquake rates were about 20 very small earthquakes per week, with the largest around magnitude 2. The ground deformation amounted to about 1.6 inches outward movement by October. These data are indicative of new magma being emplaced below the volcano, which may or may not be a prelude to a future eruption. AVO issued two information statements about this activity in April and October, but as the activity was ongoing for an extended period, AVO decided to raise the alert levels to YELLOW/ADVISORY on October 16, 2024.

Special Note on Mount Edgecumbe

A complete monitoring network was installed at Mount Edgecumbe in July 2023 while Edgecumbe was experiencing ongoing ground deformation and low rates of seismic activity that had first been noted in 2022. After a period of evaluating the typical activity at Edgecumbe, AVO moved the volcano from UNASSIGNED to GREEN/NORMAL for the first time on February 26, 2024. Low levels of seismic activity and decreasing rates of ground deformation continued throughout the year.

Above. Michelle Coombs, AVO/USGS geologist, exposes tephra and peat layers in a bog on Kruzof Island during fieldwork at Mount Edgecumbe. Photo: Abbey Nastan.
Background. Summit of Mount Spurr. Photo: Wyatt Mayo.

New AVO Website Unveiling!

2024 saw AVO make a big change in how we deliver information online—our public website, which is maintained by DGGS Volcanology Section staff, received its first major upgrade in many years.

This new website increases accessibility and was developed in coordination with internal and external stakeholders. This user-emphasis continues throughout the website, especially in our improved user-access to AVO's webcam data, as well as other near-real-time volcano monitoring data streams.

Mobile web traffic represents 35 percent of our daily users, however that number surges dramatically during events that impact the public. Our new website has been designed to be more accessible and maintain its commitment to remain mobile-friendly without sacrificing rich, in-depth content.

Under the hood, the new website also delivers information much faster than the old one, which needed caching mechanisms that required manual intervention; the new website is performance optimized, meaning users now always see the very latest information. Our web services now sit behind a reverse-proxy load-balancer, allowing us to increase capacity in the event of a major eruption.

Check out the new site!
avo.alaska.edu

For infrastructure, we shifted from a single-server model to a microservices architecture, using DGGS virtualization hosted in the UAF Butrovich Data Center. This allows for modular, scalable services that enhance flexibility and increase efficiency and reliability. Leveraging these technologies increases security, reduces downtime, and enables high-availability deployments.

AVO geologists M. Loewen (left) and C. Waythomas (right) on the north side of Shishaldin discussing lahar flow paths from the 2023 eruption. Shishaldin is in the background. Photo: Jordan Lubbers, AVO/USGS. July 25, 2024.

GEOLOGIC INFORMATION CENTER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Section Chief


Tom Cerny


Tommy Folan


Kristen Janssen


Amy Macpherson


Simone Montayne


Oralee Nudson


Chris Ramey


Pedro Rivera


Sue Seitz


Ally Steinleitner

The Geologic Information Center (GIC) provides publication, geographic information systems (GIS), and information technology (IT) support services that provide access to geologic information related to Alaska's vast resources and support for geologic hazard response. The GIC's ability to publish, host, and distribute large volumes of data supports collaborations with federal and other state organizations, minimizing duplication of effort and cost. The wide range of published services helps to better inform land management decisions and encourage investment, exploration, and development of the state's resources, resulting in a beneficial fiscal impact to Alaska's economy, worth billions of dollars. The quality of DGGS's Alaska geological database, the quality and scale of maps, and the ease of access was rated number one in the United States by the recently released Fraser Institute's 2023 Annual Survey of Mining Companies.

The GIC successfully supports the state's geologists, scientists, engineers, and decision-makers with effective, timely, and low-cost solutions to complex problems. This is only possible by having our team of highly skilled professionals embedded and integrated within the division. This allows GIC staff to (1) work closely and directly with domain experts, (2) rapidly respond to issues, and (3) develop cost effective storage and processing solutions that support the division and many others throughout the state.

In 2024, the GIC facilitated the publication of 77 new geologic reports, maps, and datasets, including six new geologic maps*:

- Surficial-geologic map of the Big Hurrah–Council–Bluff area (600 mi^2)
- Geology and geologic hazards in the Whittier area (100 mi^2)
- Surficial-geologic map of the Kivalina area (160 mi^2)
- Bedrock geologic map of the Taylor Mountain area (898 mi^2)
- Bedrock geologic map of the Western Tanacross area (1,716 mi^2)
- Bedrock geologic map of the Big Hurrah–Council–Bluff area (595 mi^2)

Twelve new geologic maps are in production for release next year, and 15 additional geologic maps are slated for GeMS conversion as part of the STATEMAP program.

*Publication numbers reported in the By the Numbers section track Fiscal Year metrics.

We served over 30 TB of digital geologic data and information from the DGGS website (dggs.alaska.gov) and geoportals. The GIC also manages DGGS's public outreach efforts, which include over 4,000 followers on X, 2,000 followers on Facebook, 730 users on LinkedIn, and 530 subscribers to the division's news feed. In addition, we respond to hundreds of in-person, phone, and email information requests.

A LOOK INSIDE PUBLICATIONS

The GIC oversees the publication and distribution of the division's numerous maps, reports, and data releases. Publications include everything from handouts on the dangers of radon to technical reports on coastal erosion and geologic maps. At any given time, there are dozens of publications in the works, each of which require different review and editorial needs, depending on the publication series and type of data. Numerous hours of review, layout, GIS work, editing, and metadata writing go into each, and that does not count the time authors spend conducting fieldwork, preparing and analyzing data, and writing the reports! GIC staff are continually looking for ways to improve the efficiency of our publication process to ensure data releases are timely, while maintaining rigorous scientific standards. Our online Publication Dashboard allows managers and staff to quickly determine the status of items in the publication queue. We have also initiated a quarterly division publications meeting to increase the visibility of publication status and priorities.

To highlight the importance of documenting and publishing authoritative process methodologies and data standards, the division introduced a new publication series, the DGGS Techniques and Methods (TM) series. This series consists of content that describes approved techniques and methods related to the collection, storage, visualization, analysis, or interpretation of scientific data. A TM may include items such as data standards, data collection guidelines, data creation guidelines, manuals, process documentation, analytical models, or software documentation. See a full list and description of the DGGS publication types here: dggs.alaska.gov/pubs/publisher/dggs.

FIELD COMMUNICATION AND SAFETY

Fieldwork is the heart of DGGS's geoscience research. GIC personnel support our scientists with training and equipment needed to operate safely in the field and respond to emergencies. Essential safety and communication equipment include helicopter helmets, radios and repeaters, satellite phones, GPS trackers, and emergency first aid bivouac kits. This year, GIC equipped roughly 36 staff on 34 distinct field projects. In addition to providing equipment support for this year's fieldwork, GIC staff co-leads the annual collaborative review of the division's Field Operations Safety Manual and fieldwork safety outcome.

GIC staff ensure DGGS staff in the field are prepared for routine and unexpected safety issues.

GIC Publications

MP 169 v. 2, AK GeMS Symbology: A description of the AK GeMS Style File
Macpherson, A.E. and others, doi.org/10.14509/31101

MP 175, Alaska GeMS geologic mapping system status report: January 1, 2016–June 30, 2023
Hendricks, M.D and others, doi.org/10.14509/31088

MP 170 v. 2, AK GeMS data dictionary: A description of the Alaska geologic mapping schema
Hendricks, M.D., and others, doi.org/10.14509/31172

DDS 21, Catalog of source data for tsunami inundation modeling in Alaska
Nicolsky, Dmitry and others, doi.org/10.14509/30953

Presentations

Using Python to Automate AKGeMS Geologic Map Legends
presented at USGS Digital Mapping Techniques Workshop Series DMT2024
doi.org/10.14509/31305

Creating, managing, and using ancillary data within the AK GeMS geologic mapping system
presented at USGS Digital Mapping Techniques Workshop Series DMT2024
doi.org/10.14509/31277

Building a comprehensive QA/QC process for AK DGGS geologic mapping
presented at USGS Digital Mapping Techniques Workshop Series DMT2024
doi.org/10.14509/31276

Geologic mapping system status report
presented at USGS Digital Mapping Techniques Workshop Series DMT2024
doi.org/10.14509/31274

GIS SUPPORT TO THE DIVISION

The GIC provides a full range of GIS support to the division. We have six dedicated GIS analysts within the division, four of which are GIC staff. Additionally, many employees at DGGS, though not officially identified as GIS analysts, are advanced users and use GIS daily for data collection, creation, storage, and distribution. We place heavy emphasis on geospatial education, a prime example being our GIS Tips and Tricks training sessions, a weekly sharing of GIS knowledge that has been going on for over six years. In addition to education, GIC supports the division with online geoportals, data services and applications, cartography guidance and creation, as well as one-on-one assistance. To meet our mission requirements as efficiently as possible, we primarily leverage the full suite of Esri GIS software through a multi-year enterprise agreement. We supplement this with their Advantage Program, which provides us additional resources to better support the division with quality GIS support.

THE DGGS GEOPORTALS—EASY ACCESS TO DATA AND APPS

Over the years, GIC personnel have built and now maintain a suite of geoportals where we host and share hundreds of geologic, elevation, and imagery datasets as well as interactive web apps for both the public and decision-makers. These geoportals allow users to share, discover, and access geologic data, maps, and interactive applications and are part of the State of Alaska Spatial Data Infrastructure managed by the Alaska Geospatial Office.

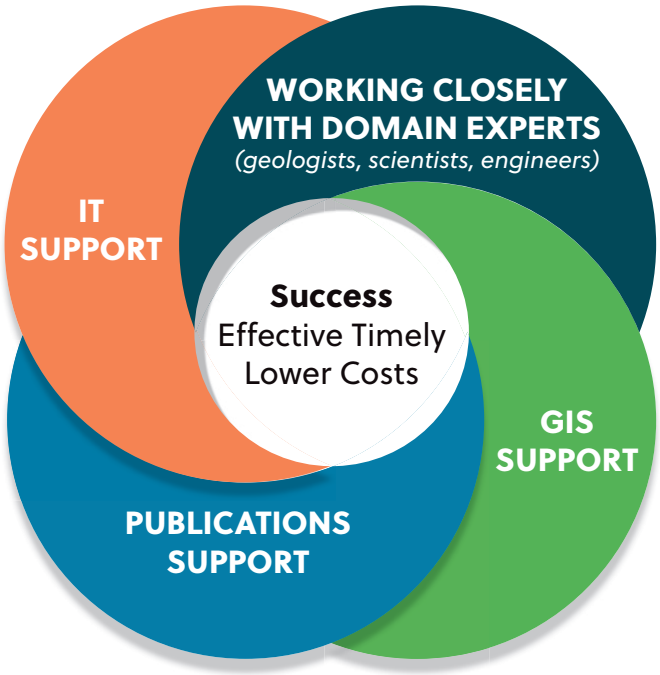
GIC staff has worked hard to increase the quality and quantity of data and web apps on the division's geoportal (geoportal.dggs.dnr.alaska.gov). Amy Macpherson, one of our geospatial

Highlight

EMBEDDED AND INTEGRATED IT & GIS SUPPORT

The GIC successfully supports the state's geologists, scientists, engineers, and decision-makers with effective, timely, and low-cost solutions to complex problems. **This is only possible by having our team of highly skilled professionals embedded and integrated in the division.** This allows GIC staff to (1) work closely and directly with domain experts, (2) rapidly respond to issues, and (3) develop cost effective storage and processing solutions that support the division and many others throughout the state.

Dedicated & Embedded IT Support *at the division level is absolutely critical*



Integrated Team *Essential to publishing, hosting, and distributing large volumes of data and services*

THIS INTEGRATED TEAM CREATES SUCCESSFUL SOLUTIONS

Lidar
Weather Stations
Cameras

Geologic Publications

Remote Desktop Servers

IT & GIS Support to AGO Imagery Portal

GIC provides critical IT & GIS support to the Alaska Geospatial Office's Imagery Portal

Field Safety Equipment

General IT Support

Massive Low-Cost Data Storage

Ability to maintain a robust IT infrastructure is the critical backbone to DGGS' ability to support Alaska

Field Portals

DGGS Geoportals

Hundreds of geologic, elevation, & imagery datasets and web apps

DGGS Website

An intuitive, up to date, and information-packed website is the "go-to" site for geologic information

AK Geologic Mapping Systems

Alaska Elevation App

GMC Inventory Management

Remote Sensing Equipment Support

Web Apps

Web apps, including Exploration Geochemistry, and Geophysics Web App, are developed and maintained by the GIC

24-Hour IT Support

IT staff is available 24 hours a day to support hazard response, unexpected outages, and other time-sensitive issues

Field Data Collection Support

GIC provides critical support for year-round field data collections including rugged, lightweight mobile servers

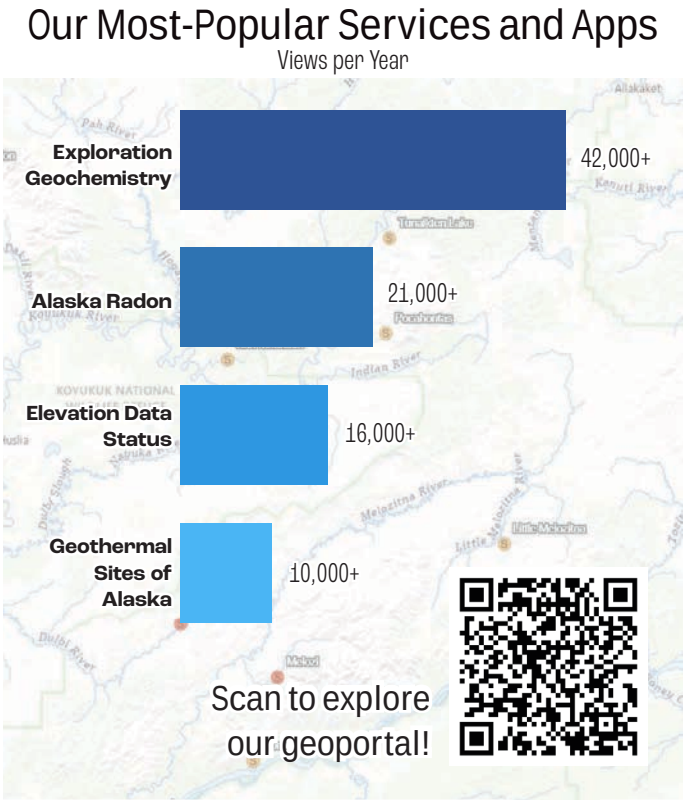
analysts, expertly functions as our geoportal primary administrator, diligently adding numerous improvements as well as increasing integration with the Alaska DNR ArcGIS Online Portal and the State of Alaska Hub site (gis.data.alaska.gov). We have over one thousand services and items stored within our DGGS Geoportal.

Working with our IT staff, we have updated our geoportal architecture. We split the components of the geoportal across multiple virtual machines, allowing us to optimize configurations for each component. This allows us to have a dedicated primary server, a dedicated image server, and a dedicated enterprise database server. These updates will support the division well into the future.

The GIC also provides access to roughly 11 TB of Alaska elevation data through our Elevation Portal (elevation.alaska.gov). In addition, we continue to provide IT and GIS support to the Alaska Geospatial Office while they build an integrated Imagery and Elevation Portal for Alaska.

IT SUPPORT

Our IT staff provides critical infrastructure and support to the division's geologists, scientists, and engineers, offering cost-effective solutions when compared to cloud services. Our team of highly skilled Alaska-based IT professionals provide effective, timely, and low-cost solutions to address our unique and complex needs. They work closely with domain experts, rapidly respond to issues, and develop economical storage and processing solutions that support DGGS and many others throughout the state. With a focus on local staff, local storage, and home-grown solutions, DGGS IT ensures that our services are not only efficient but also contribute to the local economy and community.



DGGS's catalog of websites is an integral component to meeting our mission, which includes providing not only timely and accurate data related to Alaska's natural resources, but also for the systematic collection, evaluation, archiving, and distribution of geologic hazards data. The importance of this shared resource is emphasized by the fact that our website distributed over 30 terabytes of data in 2024.

PROGRAMMING

The GIC IT staff provide essential programming for a wide range of projects within the division, while also maintaining multiple applications and databases: publications, photo, geochemical, elevation, and the GMC online inventory. This in-house programming support allows us to release and maintain unique applications, tailored to the specifics required for the data (e.g., the Palynology Index, doi.org/10.14509/30900).

THE ALASKA GEOLOGIC MAPPING SYSTEM

GIC staff are critical for developing and maintaining the Alaska Geologic Mapping System, which produces standards-based, Geologic Mapping Schema (GeMS)-compliant geologic maps and data for publication. The system controls the process of collecting, producing, converting, packaging, publishing, and sharing geologic map data. The system includes hardware, GIS software, data standards (GeMS), and well-defined organizational procedures that includes a 16-phase workflow to ensure high quality products are created and shared. Over 70 standards-based geologic map databases have been created and shared through this system with an expected 50 more to be published within the next two years.

This past year we published and delivered to the USGS a comprehensive report on the status of our system: ***Alaska GeMS geologic mapping system status report*** (dggs.alaska.gov/pubs/id/31088). The publication provides a history of our development process, an overview of the Alaska Geologic Mapping System, a description of our data and symbology standards, specifics of both the AK GeMS single-map and AK GeMS multi-map implementations, an overview of our organizational procedures, and a description of how we package, publish, and share our geologic map information.

The report highlighted our primary finding that the development of a formal, documented system based on published data and symbology standards is a major success. DGGS now produces higher quality standards-based map products at a significantly faster rate than in the past.

Between 2013 and 2020 we published 19 new geologic maps (in various data formats) at a production rate of 2.4 maps (and data) each year. **Since 2021, with the Alaska Geologic Mapping System, we have published or converted 45 maps into our AK GeMS data standard, at a production rate of 18 a year. This is over a seven-fold increase in productivity!**

AK GEMS PRODUCTION RATE (MAPS/YEAR)

This year we also published updated symbology and data standards. Their release marks another major achievement as these standards are cornerstones of our successful mapping system. We published an updated version of *AK GeMS symbology: A description of the AK GeMS Style File* (doi.org/10.14509/31101) in which we increased the number of supported symbols and transitioned into support for ArcGIS Pro's new updated Style File format. We also published *AK GeMS data dictionary: A description of the AK GeMS database schema* (doi.org/10.14509/31172). Our AK GeMS standard extends the USGS's GeMS basic standard by placing greater focus on modeling geologic features and adds advanced capabilities. AK GeMS supports our single-map production processes while also allowing for multiple maps in a modern enterprise relational database.

An example of the benefits of having documented symbology and data standards is the development

that Amy Macpherson led this past year to automate the generation of geologic map legends, saving us tens of hours on each geologic map that we produce. No longer do we need to manually manipulate the individual graphics that make up a legend. Instead, our AK GeMS database holds the key to automating the formatting and layout of the legend with the use of Python scripting.

GIC staff, led by Ally Steinleitner, also developed and implemented a comprehensive, semi-automated quality control process that has dramatically improved data quality and the speed at which we can deliver data to the USGS—we have delivered over 70 data packages to the USGS this year. Building on this success, we are leveraging support offered though our Esri Advantage Program to modernize our quality assurance/quality control (QA/QC) processes and data schema.

GIC staff, specifically Pedro Rivera, work on our AK GeMS multi-map geodatabase and development of multi-map services and web apps. With assistance from the Esri Advantage Program support, we have transitioned our multi-map geodatabase into the AK GeMS version 2 standard and have ingested over 70 map databases.

In May, GIC staff and other DGGS geologists attended the annual Digital Mapping Techniques Workshop in Illinois and presented on several topics, including:

- Macpherson, A.E., and Barrette, Jeff, 2024, Using Python to Automate AKGeMS Geologic Map Legends. doi.org/10.14509/31305
- Hendricks, M.D., 2024, Creating, managing, and using ancillary data within the AK GeMS geologic mapping. doi.org/10.14509/31277
- Steinleitner, A.M., and Hendricks, M.D., 2024, Building a comprehensive QA/QC process for AK DGGS geologic mapping. doi.org/10.14509/31276
- Hendricks, M.D., Athey, J.E., Montayne, Simone, Wyatt, W.C., Macpherson, A.E., and Buchanan, J.W., 2024, Geologic mapping system status report. doi.org/10.14509/31274

West Susitna project staff during 2024 fieldwork. GIC work with staff to ensure accurate field data collection happens in the field so mapping back in the office is efficient.

ALASKA GEOSPATIAL OFFICE

Leslie Jones

Development and management of accurate and reliable geospatial data saves lives; enables every sector of the workforce to do their jobs more effectively and efficiently; supports the state's private sector economy; and shows Alaska is open for business. Indeed, maps are the basis for all decision-making. Almost every question we ask is answered with a "what, where, and when" about locations, patterns, and changes over time—these are nuts and bolts of the Alaska Geospatial Office's (AGO) mission to support informed decision-making.

Geospatial Data: The Secret Sauce for Building Accurate and Reliable Maps

Did you know Alaska received a D in the most recent National States Geographic Information Council Geospatial Maturity Assessment that assesses the completeness, accuracy, and availability of geospatial data for every state in the nation? AGO aims to fix that!

A map is like a lasagna, consisting of various layers of geospatial data such as road networks, addresses, land ownership boundaries, schools, trails, rivers, and hospitals.

Why it matters:

Map once and use many times. The same map is used to answer unlimited questions related to economic investment, emergency response, supply chains, and resource development.

The AGO is partnering with agencies and organizations across the nation to fill data gaps and improve data availability, thus reducing duplication and wasted resources. We accomplish this through coordination of the Alaska Geospatial Council (AGC; agc.dnr.alaska.gov).

Data Governance: Management and Policy to Support Data Quality and Reliability

Have you ever wondered how your address makes its way to Google Maps? Maybe you haven't thought much of it, but we do every day. Think of data governance as the "rules of the game" for sharing and using geospatial data. It ensures that data are managed properly, shared fairly, and used responsibly.

The Geospatial Data Act of 2018 was put into federal law to support geospatial data governance and reduce duplicative spending across all levels of government.

Why it matters: Without rules, there would be conflicting data sources, wasted resources, and bad decision-making.

The Alaska Geospatial Office works across sectors and partnering organizations to create and implement governance for Alaska's geospatial data.

Data Pipelines: the Delivery System

Think of data pipelines as the system that moves geospatial data from where they're collected and stored to the people and tools that need them in a clean and organized way. Data governance is the backbone and foundation for implementing data pipelines.

Why it matters: Without data pipelines, data flow inefficiently—we would face big problems with outdated and inaccurate maps, agencies would duplicate data collections and expenditures, and the lack of immediate access to data would slow decision-making.

The Alaska Geospatial Office administers the State Geoportal (gis.data.alaska.gov), which connects data hubs managed by local, state, and federal governments and universities to ensure decision-makers are accessing real-time data from agencies and organizations across the state, reducing time spent sorting through websites and responding to data requests.

DGGS Energy Resources geologist Trystan Herriott during a fieldtrip to the North Slope.

ALASKA GEOSPATIAL COUNCIL

The AGC coordinates across stakeholder groups (federal, state, and local governments; universities; Tribal and Native corporation; non-profit and private organizations) to fill gaps in essential geospatial data, reduce duplication of data collections and management, cost-share projects to increase efficiencies in resource spending, and improve data accessibility for decision-making. In 2024, the AGC added an Energy and Utilities Working Group. There are now fourteen working groups supported by membership from across the nation. These include: Imagery and Elevation, Hydrography, Wetlands, Cadastral, Vegetation, Soils, Food Security, Enterprise, Transportation, Geodetic, Coastal and Ocean, Unmanned Aerial System (UAS) Policy, Energy, and Utilities working groups. To learn more, visit agc.dnr.alaska.gov.

The AGC continues to support the mission of the Alaska Mapping Executive Committee through regional and local coordination. In 2024, this partnership resulted in 100 percent completion of wetland mapping (National Wetland Inventory) and is supporting statewide mapping related to hydrography (surface waters), elevation (lidar), vegetation, shoreline, and nearshore seafloor mapping.

THE STATE GEOPORTAL

The State Geoportal, administered by the AGO, continues to provide access to location-based data, maps, and decision-support tools, which makes the state's vast collection of spatial data easier for the public to locate and use. The portal ensures decision-makers are accessing real-time data from agencies and organizations across the state, thus reducing time spent sorting through websites to respond to data requests. The AGC provides a forum for data managers across the state to create a shared vision of governance and policy, thereby ensuring long-term viability of the state's geospatial data assets. The geoportal serves 1,900 datasets and maps from 20 federal, state, and local governments across Alaska. In 2024, the State Geoportal was visited by more than 65,000 users.

IMAGERY PROGRAM AND PORTAL

High-resolution imagery is widely used throughout the public and private sectors to support informed decision-making. DNR uses satellite imagery to monitor wildfires, support oil and gas permitting and compliance, monitor trespass and compliance on state lands, make shoreline erosion assessments, and assist with emergency response. For the past three years, the AGO has coordinated a contract with Planet Labs, which is cost-shared between DNR divisions. Using satellite imagery to view remote locations around the state reduces the cost of many division operations, which often require travel to these locations via plane or helicopter. For example, the Division of Forestry & Fire Protection uses helicopters to track wildfire perimeters, which is costly and dangerous. Over the past two years, the use of satellite technologies has enabled the division to reduce the number of helicopter flights and increase efficiencies in digitizing wildfire perimeters, resulting in substantial cost savings.

Imagery is made publicly accessible through the Imagery Portal, which received more than 267 million data requests from179,302 unique users in 2024.

ALASKA GEOLOGIC MATERIALS CENTER

GMC staff from left to right: Kurt Johnson, Alex Garcia, Gabriella Efird, and Kaleb Smith.

The Alaska Geologic Materials Center (GMC), operated by DGGS, hosts an archive of geologic data with an estimated replacement value of $35 billion. The decades' worth of data from energy, mineral, and geologic collections are housed in the Anchorage-based facility, a venue that provides a wide range of users (industry, government, academia, and the public) access to these samples for identifying new resource prospects and increasing our geologic knowledge of the state.

The Anchorage repository opened on July 1, 2015, and has completed its ninth fiscal year since moving from its original location in Eagle River. Fee collection began in fall 2018. There were more than 650 visits to the facility in 2024. While this is a drop from the 1,151 visitors in 2023, many of the visitors counted in 2023 represent the one-time occurrence of a several-month-long pilot curriculum to train high school students as mineral technicians.

The GMC's database-driven search engine allows users to view a real-time inventory of nearly 781,000 public sample items quickly and easily before visiting the facility. This innovative and complex database and online search engine was developed in-house by DGGS staff and continues to serve user needs. In 2024, 2 TB of data were downloaded from GMC web pages.

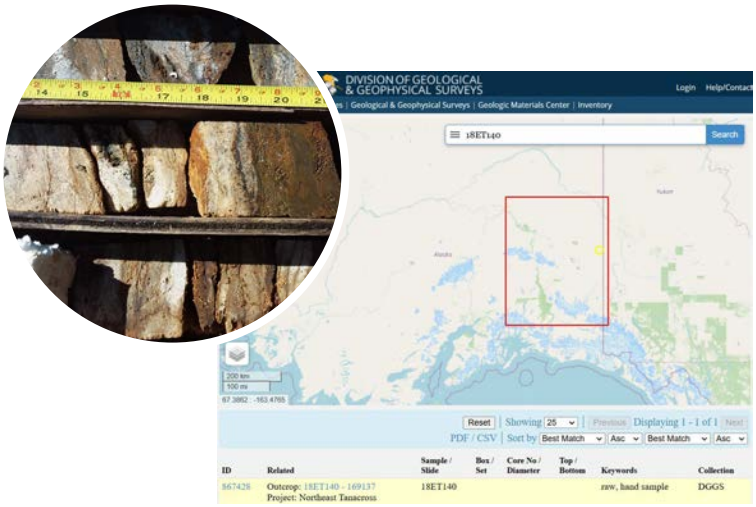
The GMC's overarching objectives are to physically and digitally curate its collection and expand global access to materials to stimulate exploration and development of Alaska's resources. Recent procurement of automated, nondestructive scanning equipment will allow for the digital visualization and distribution of these datasets to the global geologic community.

2024...by the numbers

650 visitors

90,000 ft² repository

782,000 public inventory items



After a project is completed and the analyzed results and data have been published, rocks and samples collected by DGGS geologists in the field are sent to the GMC for permanent storage. The GMC's inventory database (maps.dggs.alaska.gov/gmc/) enables visitors to find the exact rock or sample referenced in a publication.

After several years of making strides towards acquiring non-destructive scanning equipment at the GMC, a scanning platform was selected. The HySpex scanning platform is expected to be delivered in March 2025, and initial production scans of mineral and energy cores could start as soon as July 2025. A pending federal fiscal year 2025 USGS National Geological and Geophysical Data Preservation Program (NGGDPP) grant would support personnel costs, data storage hardware, and related programming needs.

Geologists from independent and major energy companies continue to represent the most frequent visitors to the GMC and travel to Anchorage to sample and examine tens of thousands of feet of drill core and cuttings. As production declines within the mature Prudhoe Bay oil field, it is essential to encourage oil and gas exploration and development by the industry elsewhere in Alaska. Strong interest in the North Slope Nanushuk play continues, and several industry workshops have been hosted at the GMC.

Government researchers were the second-most frequent visitors, followed by those from the mining industry, who examined GMC core samples to identify potential critical minerals like nickel, cobalt, REEs, or other deposit types.

Interest in geologic carbon sequestration, including the potential for chemical capture of carbon dioxide, and are driving new client requests. Visitors and academic researchers also find value for the educational opportunities offered by this facility.

The following list of entities and organizations that visited the GMC illustrate the wide-ranging interest in the geologic inventory:

Arctic Slope Regional Corp
Calista Corp
ConocoPhillips Alaska
Core Labs
Fugro
Geolog
Hilcorp Alaska
Santos (Oil Search)
Thyssen Petroleum
Felix Gold
Kobold
MDF Global
Polar X
Alaska Oil and Gas Conservation Commission
Alaska Dept. Environmental Conservation
Alaska Volcano Observatory
Sandia National Laboratories
US Bureau of Land Management
US Geological Survey
Stanford University
University of Alaska Anchorage
University of Alaska Fairbanks
Alaska State Legislators
Senator Murkowski's Office

The GMC building seen from above.

RELATIONSHIPS WITH OTHER AGENCIES

DGGS develops its strategic programs and project schedules through consultation with the many users of geologic information: state and federal agencies, the Alaska Legislature, the congressional delegation, professionals in the private sector, academia, and individual Alaskans. Their input to DGGS programs comes through the Alaska Geologic Mapping Advisory Board (GMAB), liaison activities of the Director, and personal contact between DGGS staff and these groups.

State Agencies

DGGS provides DNR and state agencies with routine analyses and reviews of various geologic issues such as geologic hazards; evaluations of pending oil and gas lease tracts; area plans; competitive coal leases; geologic assessments of land trades, sales, selections, or relinquishments; oil and gas and mineral potential; and construction materials availability.

Each year DGGS works closely with:

- DNR DOG, on issues related to energy resources, and in providing geologic control for the subsurface oil-related geologic analyses conducted by DOG.
- DNR Office of Project Management and Permitting, for technical expertise during large project permitting and to report on the status of Alaska's mineral industry.
- Department of Revenue, to report on the status of Alaska's mineral industry.
- DHS&EM, in the Department of Military and Veterans Affairs, and the Department of Environmental Conservation, to evaluate volcanic and other hazards, develop scenarios for and respond to geologic hazard events, and update the State Hazard Mitigation Plan.
- AKDOT&PF, UAF, and other agencies to assess the impacts of landslides, slope failures, avalanches, flooding, erosion, and construction materials availability.
- Alaska Energy Authority to evaluate the potential hazards and viability of proposed hydroelectric, geothermal, and other energy projects; to provide technical expertise on geothermal resource potential; and to evaluate resource potential around the state that might provide viable alternatives for energy development in rural Alaska.
- DNR's Division of Mining, Land and Water to evaluate groundwater issues, address land selection and sale questions, and to report on the status of Alaska's mineral industry.

In recent years, DGGS has also collaborated with the Alaska Natural Gas Pipeline project, Alaska Gasline Development Corporation, and the State Pipeline Coordinator to assist in geologic data collection and hazards assessment for proposed natural gas pipelines.

DGGS also assists in large inter-division or other one-time efforts responding to special needs that are generally supported by interagency fund transfers. Smaller requests are funded by DGGS's annual general fund appropriation.

Local Governments

Many of the cooperative efforts implemented by DGGS with borough and municipal governments are conducted on a mutually beneficial but

informal basis. For example, DGGS participates in a federally funded cooperative program to develop tsunami-inundation maps for coastal communities. In communities for which inundation maps have been prepared in recent years, DGGS works closely with collaborators and city and borough governments to design project outputs to meet community needs for planning evacuation areas and routes.

DGGS works closely with local communities to help assess hazards and alternatives for mitigating the effects of erosion, flooding, and other surface processes that threaten their sustainability. DGGS also sends personnel to respond to natural disasters, such as the Ketchikan landslide event in August 2024. Similarly, DGGS works with rural communities to help assess potential local energy resources as alternatives to diesel fuel. During volcanic unrest and eruption, DGGS, as a partner in the AVO, communicates with local villages—as well as with industry sectors, the aviation community, and the military—to share information and observations of volcanic unrest.

The University of Alaska

DGGS has a longstanding and productive professional association with geoscientists and students at the University of Alaska. University of Alaska faculty often work as DGGS project team members on a wide range of collaborative research projects. University student interns are also an important part of the DGGS workforce; while working on DGGS projects, students learn a wide variety of geology-related skills. Some graduate students are able to apply their DGGS intern work to their thesis projects through research programs established through a Memoranda of Agreement with the UAF Department of Geosciences. DGGS and the university make frequent use of each other's libraries and equipment and University of Alaska faculty and students also frequent the Geologic Materials Center in Anchorage, where faculty conduct core logging classes. DGGS's Volcanology Section has a long-term cooperative relationship with the UAF Geophysical Institute, resulting from the AVO partnership.

Federal Agencies

DGGS has cooperative programs with numerous federal agencies, including the USGS, the National Oceanic and Atmospheric Administration, the U.S. Fish and Wildlife Service, National Aeronautics and Space Administration, the National Science Foundation, and periodically with FEMA, the U.S. Department of Housing and Urban Development, the Bureau of Land Management, and the U.S. Department of Energy. In the past, DGGS has also engaged in cooperative programs with the Bureau of Ocean Energy Management.

DGGS receives federal funds from matching grants, for which the division must compete nationally with other organizations on a yearly

Sean Regan, an assistant professor in the UAF Department of Geosciences, records observations and notes in the field during 2024 fieldwork. He is one of many UAF faculty members who collaborate with DGGS.

basis. DGGS has been successful in securing federal funds to support mineral inventory mapping, surficial and earthquake hazards-related mapping, geologic-hazards evaluations, and studies related to oil and gas and geothermal potential. Although DGGS has historically been very successful in receiving federal grants and appropriations, the process is competitive, and these funds are therefore project-specific, complementary to state-funded programs, and do not replace state general fund support. Federal funding is pursued only for projects that advance and serve the division's statutory mission.

Two ongoing cooperative federal programs have provided support for key elements of the DGGS mission for many years. One is AVO—a partnership established in 1988 consisting of USGS, DGGS, and the UAF Geophysical Institute. The USGS funds and administers the program for the purpose of providing a coordinated approach to mitigating volcano-hazard risks to the public, state infrastructure, and air commerce. The second ongoing program is the STATEMAP component of the National Cooperative Geologic Mapping Program, which was established by Congress in 1992 and is administered by the USGS. STATEMAP provides matching funds for geologic mapping projects according to priorities set by GMAB.

DGGS has been successful in receiving cooperative agreements from the NGGDPP and the National Cooperative Geologic Mapping Program. The National Geological and Geophysical Data Preservation Program (NGGDPP), funded by the USGS, has supported several DGGS projects to preserve and make geologic information publicly available. STATEMAP funds provide a stable source of federal funding for geologic mapping in the state. Both of these programs require a 1:1 match in state funding.

Anaktuvuk Pass, where ASTAR geologists conducted sand and gravel resource mapping during summer 2024 fieldwork. Photo: Sandra Walser, DGGS.

ALASKA GEOLOGIC MAPPING ADVISORY BOARD

The Alaska Geologic Mapping Advisory Board (GMAB) guides DGGS in pursuing its goal of providing earth science information to the Alaska public. A number of prominent geologists and community leaders, with a variety of backgrounds and a broad spectrum of experience in Alaska, have agreed to serve on the advisory board. The board held its first meeting in Fairbanks on October 22, 1995, and normally meets three times a year to discuss state needs, review DGGS programs, solicit and welcome comments and suggestions from the public, and provide recommendations to the state geologist.

Current members of the board are:

Matthew Hanson, Chair

Resource Manager, Doyon, Limited. Mr. Hanson represents Alaska Native corporations and communities and helps manage natural resource issues. He has expertise in land management and mineral exploration.

Kyle Brennan

Professional Engineer and Vice President, Shannon & Wilson Anchorage Office. Mr. Brennan's experience includes road and rail infrastructure; pedestrian walkways, trails, and bridges; pavement analysis and remediation; utilities and power generation/distribution; new building development; and airports and seaports.

Scott Digert, PE

Professional Engineer and Alaska Resource Development Manager, BP Exploration Alaska (retired). Mr. Digert represents the industry sector and his expertise includes energy project evaluation, exploration, development, and production.

Mischa Ellanna

Geologist, Bristol Bay Native Corporation. Mr. Ellanna has nearly three decades of experience in land management and mineral exploration. He has an strong background in geochemistry, geophysics, GIS, and construction aggregates.

Dr. Nicole Kinsman

Deputy Regional Director, NOAA/NWS Alaska. Dr. Kinsman has many years of experience in geospatial science and technology, environmental observing, and natural hazard response/mitigation.

Russel Kirkham

Manager, Alaska Coal Regulatory Program for the Division of Mining, Land and Water, State of Alaska. Mr. Kirkham has many years of experience managing coal resources and mining-related regulations.

Dr. Douglas Kreiner

U.S. Geological Survey, representing the federal government, mineral resources, and mapping interests. Dr. Kreiner is Associate Center Director, Geology at the Alaska Science Center, specializing in mineral resources and geologic mapping.

Dr. Paul McCarthy

Professor, Department of Geosciences, University of Alaska Fairbanks. Dr. McCarthy has research interests in paleo-landscape evolution, alluvial architecture and nonmarine sequence stratigraphy. He represents the University of Alaska Fairbanks on the Board.

Rob Retherford

President, Alaska Earth Sciences. Mr. Retherford has decades of experience managing mineral exploration and geoscience projects in Alaska.

Dr. Caixia Wang, PhD

Chair of Department of Geomatics, University of Alaska Anchorage. Dr. Wang is an associate professor and director of the GeoComputing Lab, with research interests in the intersection of academia and industry in the geospatial engineering, geospatial artificial intelligence (GeoAI), environmental monitoring, remote sensing, and GIS.

DGGS MISSION AND HISTORY

Department of Natural Resources:
Develop, conserve, and enhance natural resources for present and future Alaskans.

Division of Geological & Geophysical Surveys: *Determine the potential of Alaskan land for production of metals, minerals, fuels, and geothermal resources, the locations and supplies of groundwater and construction material; and the potential geologic hazards to buildings, roads, bridges, and other installations and structures (AS 41.08.020).*

HISTORY

DGGS evolved from Alaska's Territorial Department of Mines. That heritage is reflected in the division's ongoing commitment to the application of geology to improve the welfare of Alaska citizens. The current name and mission of the division were established in 1972 with the passage of Alaska Statute AS 41.08.

- Territorial Department of Mines, prior to 1959
- Division of Mines and Minerals, 1959–1966
- Division of Mines and Geology, 1966–1970
- Division of Geological Survey, 1970–1972
- Division of Geological & Geophysical Surveys, 1972–Present

LEADERSHIP

The following qualified professional geoscientists have served as state geologist:

- Jim Williams, 1959–1971
- William Fackler, 1971–1973
- Donald Hartman, 1973–1975
- Ross G. Schaff, 1975–1986
- Robert B. Forbes, 1987–1990
- Thomas E. Smith, 1991–1995
- Milton A. Wiltse, 1995–2002
- Rodney A. Combellick (Acting), 2003–2005
- Mark D. Myers, February–October 2005
- Robert F. Swenson, 2005–2013
- Steven S. Masterman, 2013–2022
- David L. LePain, 2022–2023
- Kenneth Papp (Acting), July–December 2023
- Melanie Werdon, December 2023–present

By statute, the state geologist serves as the director of DGGS and is appointed by the DNR commissioner. Since the early 1970s, state geologists have been selected from lists of candidates prepared by the geologic community and professional societies in Alaska. A department order in 2002 formalized a process whereby the Geologic Mapping Advisory Board oversees evaluation of candidates and provides a list to the commissioner. The qualifications and responsibilities of the state geologist and the mission of DGGS are defined by statute.

ORGANIZATION

DGGS is one of seven divisions and six offices in DNR. Under the overall administration of the director's office, DGGS is organized into six sections, the Geologic Materials Center, and the Alaska Geospatial Office (see organization). DGGS also administers the Alaska Seismic Hazards Safety Commission.

New Staff–Welcome!

Halbe Brown

Halbe Brown joined DGGS's Geologic Hazards Section in December. He is working on the Fairbanks Sample Rescue Project to help identify and process a large collection of samples donated from UAF (which now resides at the GMC). He obtained a bachelors in geology from UAF in May 2024. Originally from Denali Park, Alaska, he spent time working there for the National Park Service while obtaining his degree. Outside of geology he has interests in film and spends a lot of his time reading.

Jamie Buscher

Jamie joined DGGS's Hydrology & Surficial Geology Section in Anchorage in September 2024 as the new Hydrology Program manager. Before arriving in Alaska, his geoscience path started in southern California, where the regular exposure to earthquakes, landslides, and flooding sparked a connection to geology while he studied at Pasadena City College. He transferred to the University of California, Los Angeles, to pursue a bachelor's degree in geology and became particularly interested in structural geology and tectonics from coursework and a summer as a field assistant in Xinjiang, China. After graduation, Jamie worked in the geotechnical and environmental industries,where he developed a strong interest in tectonic geomorphology and decided to attend graduate school at Virginia Tech. As a graduate student, he applied (U-Th)/He dating and GIS analyses to constrain the extent and timing of exhumation in the Chugach-St. Elias Mountains in southern Alaska and the northern San Gabriel Mountains along the San Andreas fault. He received an MS in geological sciences and a PhD in geosciences. After graduation, he returned to southern California to work at Chevron in Bakersfield, where he planned and modeled heavy oil extraction from folded diatomite units found along the San Andreas fault. Jamie again left industry to return to academia for a series of postdoctoral researcher positions at Leibniz Universität Hannover (Germany), Università di Napoli "Federico II" (Italy), and Universidad de Chile, applying (U-Th)/He dating and GIS analyses to quantify the landscape development of the central Menderes Massif (Turkey), southern Apennines (Italy), and Chilean Andes. As a postdoctoral researcher, he taught several courses, including General Geology, Field Methods, and GIS for Geologists at the undergraduate and graduate levels. During this time, the scope of his research extended to drainage systems, which included analysis of stream profiles to constrain the extent of surface uplift in tectonically active mountain belts. After several years overseas, Jamie's wife accepted an Assistant Professor position in volcanology at the University of Alaska Anchorage (UAA), and the family moved to Anchorage. Jamie taught Structural Geology and Field Methods for one semester at UAA and then switched careers to work as a hydrologist at the Division of Mining, Land and Water, before taking his current position at DGGS. When Jamie is not hunched over a computer or battling the natural and digital elements in the field, he enjoys spending time with his wife and son and traveling to see family in California, New York, and Italy.

Nick Crawford

Nick joined DGGS's Hydrology & Surficial Geology Section to work on the ASTAR project. He coordinates field logistics, manages data, and conducts surficial geology mapping field work. Originally from Massachusetts, he received his BS in geology from Bowdoin College in Maine in 2009. He moved to Fairbanks upon graduation, where he found himself pursuing a career as a cross country ski coach. He left Fairbanks to earn his master's degree in exercise physiology from Boise State University. Nick moved back to Fairbanks in 2015, which he now calls his permanent home. In the winter months, Nick can be found exploring the trails around the Interior by dog team, ski, fat bike, or snowmachine. During the summer, Nick enjoys backpacking, rafting, packrafting, mountain biking and hunting, often with his wife and dogs.

Malcolm Herstand

Malcolm originally started with DGGS in the Volcanology Section in 2019 as a volcano monitoring technician. After a stint in the USGS arm of AVO, Malcolm returned to DGGS, this time as part of the Geologic Hazards Section. In his new role, Malcolm installs and maintains instrumentation for hazard monitoring, primarily for the Climate and Cryosphere and Landslide Hazards programs. In addition to fieldwork on weather stations, slope instability sensors, and other remote systems, Malcolm works on data processing and visualization interfaces. With a background in Alaska's hazard-rich mountains and experience in Mountain Rescue, Malcolm especially enjoys working with community partners to develop monitoring solutions suitable to Alaska's steep terrain and challenging climate.

Aleena Merin Jose

Aleena joined DGGS in August 2024 as a geologist 2 in the Hydrology & Surficial Geology Section. She earned her bachelor's degree in geology and water management from Mahatma Gandhi University, India, followed by a master's degree in geology from the University of Mysore, where she was awarded a gold medal for academic excellence. In 2023, she and her family relocated to Chicago.

Aleena joined DGGS to work on the ASTAR project, where she is responsible for creating a comprehensive reference database to support the project's objectives, along with helping to compile and evaluate data for other ASTAR publications. Her work supports efforts to address critical infrastructure needs on the North Slope, aiding in resource development and improving transportation strategies in this challenging environment.

The opportunity to work with DGGS has allowed her to expand her expertise and immerse herself in Alaska's unique culture. She also enjoys the northern lights and adapting to the snowy lifestyle.

Outside of work, Aleena loves cooking, watching Indian movies, and exploring Alaska's breathtaking landscapes with her mother. They share its beauty and wonder through their adventures together.

Jamshid Moshrefzadeh

Jamshid ("jam" like the fruit spread, "sheed") Akbar Moshrefzadeh joined the DGGS Mineral Resources team in June of 2024. They have a BS in geology from the University of Wisconsin River Falls, and both an MS and PhD in geology from the University of Alaska Fairbanks. Jamshid's PhD, titled Pinpointing Magma Processes in Time and Space, focused on volcanology, igneous petrology, and geochemistry. Their unique expertise lies in modeling the chemical diffusion of elements across mineral zones to determine timescales of magmatic processes and in analyzing shared compositional zoning across multi-phase crystal clusters to unravel the sequence of events that comprise their geologic history. In addition to their extensive laboratory experience using the Electron Probe Microanalyzer, carbon coaters, petrographic microscopes, and column chromatography, Jamshid has participated in fieldwork campaigns in a wide variety of harsh environments, including but not limited to Interior Alaska, the Aleutian Islands, Kamchatka, Iceland, New Zealand, Italy, and the Pacific Northwest. In their current DGGS position, Jamshid assists with geochemical and petrological analyses, database organization, and fieldwork to support ongoing geologic mapping efforts in Alaska.

Jamshid was born and raised in Minnesota and enjoys visiting family there as often as possible. When not looking at rocks or spreadsheets, Jamshid can be found with their nose in a book, or with a sword in hand at fencing club. Jamshid lives happily in Fairbanks with their black cat, Sempra, and looks forward to their future with DGGS.

James Salvador

James joined DGGS in December 2024 as a geologist 1 in the Geologic Hazards Section to work on groundwater quality projects. He recently graduated from the University of California Santa Cruz where he studied environmental and conservation work. He gained experience working on projects across Washington and California, where he was dedicated to protecting natural ecosystems. James is an avid outdoors enthusiast, home chef, and Green Bay Packers fan. Welcome, James!

Jess Thurman

Jess joined DGGS in 2023 as a non-permanent admin assistant. She was born and raised in Fairbanks with her older sister and younger brother. Growing up, she loved to camp and be out in the wilderness; her favorite part was being with family and discovering more of Alaska! Her childhood pastime of playing by the river and skipping rocks with her siblings has grown into a slight obsession with rock hunting and collecting whenever she is out on an adventure with her own family. Jess and her husband are parents to 3-year-old (soon to be 4!) twin boys. She absolutely loves being a mom and showing her kids the excitement and beauty of Alaska.

In November 2024, Jess accepted a permanent position as an admin assistant 2 at DGGS. She has over seven years of experience in administrative and office work, and at DGGS she provides support for timesheets, invoice and receipt processing, and inventory tracking, and is always willing to step in to help. She is very happy to have found her work home at DGGS and cannot wait to see what the years may bring!

Kamil Qureshi

Kamil joined DGGS's Energy Resources Section in February, following completion of his PhD at the University of Houston, where he combined remote sensing and seismic data with field observations to model the neotectonics and structural evolution of the western Himalayas. Kamil brings a breadth of experience to our program, including past work for domestic and international oil and gas projects. He also has strong skills in geospatial data analysis and subsurface geophysical interpretation, both of which will benefit ongoing and future applied energy resource projects in Alaska. In addition to English, Kamil also speaks Urdu, Pahsto, and Hindko languages. Kamil and his family have quickly adapted to life in the Interior and recently welcomed their second child!

Farewell!

Katharine (Kate) Bull

We have so much to celebrate about Kate and the long and diverse history she has working as a geologist in Alaska. Kate's knowledge encompasses an extraordinarily broad range–from mineral exploration to volcanology, and from ancient volcanic deposits through modern volcanic processes. Kate retired from DGGS in 2024 after serving as a geologist in various capacities since 1981, when she first started working as a DGGS intern with Tom Bundtzen, Wyatt Gilbert, and Diana Solie. Kate credits this early experience working at DGGS as her introduction to field mapping and learning from the best.

Kate first came to Alaska in 1978, traveling on her own, and ended up in Homer. She worked at a cannery in the Bush up the Fox River valley, as one of only two women on the unloading crew at the cannery docks. Although she had originally planned to go to college in Olympia, Washington, after seeing Alaska she instead started at UAF in January 1979. She did eventually transfer to the University of Washington in the fall of 1981–although she returned to complete her final semester at UAF so she could take an ore deposits class from Dr. Rainer Newberry (also a DGGS staff member!). She earned a Bachelor of Science from UW in 1984. After that, Kate returned to Alaska to work at the Mineral Industry Research Lab in the winter and Bear Creek Mining Co. (Kennecott) in the summer. In the fall, she was offered a Doyon-funded MS project by Tom Bundtzen and Rainer Newberry and began fieldwork in Flat in 1985. After earning her MS in 1988 (record time for a Rainer and Sam Swanson student!), Kate joined Dihedral Exploration, a partnership contract company specializing in steep-terrain mineral exploration. Working with Dihedral, Kate traveled the world, including trips to the lower 48, Greenland, Nepal, and Argentina, but most especially Alaska and Canada. Kate continued doing contract mineral exploration work in steep terrain after her Dihedral Exploration partner was killed in an avalanche in 1992.

In 2001, Kate went to Tasmania to earn a PhD in volcanology with Jocelyn McPhie. Her doctorate focused on volcanic facies of an explosive and effusive submarine volcanic complex in western New South Wales, Australia. In 2005, she returned to DGGS to work for the Alaska Volcano Observatory (AVO) under Chris Nye. She also completed her PhD degree in 2006. Between 2005 and 2012, Kate was instrumental to AVO's responses to the Augustine 2006 and Redoubt 2009 eruptions, especially with her breadth of geologic knowledge and her across-Alaska contacts. From 2012 to 2013, Kate branched out from volcanology to work as a contractor for other DGGS projects like the Whittier

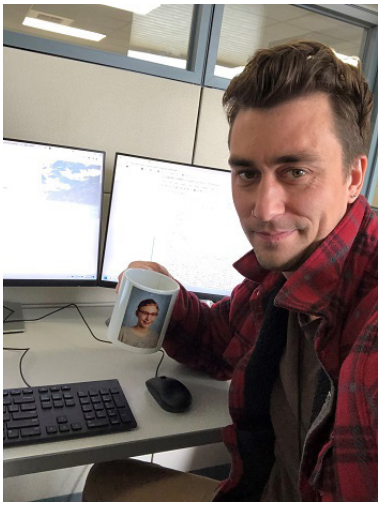
landslides project and Energy Resources work in Cook Inlet. In 2014, Kate returned to Australia to work as a petrologist and volcanologist at the Geological Survey of New South Wales.

In 2019, AVO began an extremely ambitious field program called "Analog to Digital" (A2D), replacing all analog instruments in our monitoring network with digital devices. This work needed someone exceptionally skilled in remote Alaska logistics. Kate rode to the rescue and returned to DGGS as the A2D logistics coordinator. Kate's dedication and knowledge are a considerable part of why that project was a resounding success despite the challenges brought on by a global pandemic. Kate also continued to contribute her geologic expertise to mapping efforts led by energy and landslides.

Kate's time at DGGS was marked by her willingness to pitch in and help when needed, from recording episodes of AVO Radio to making sure the DGGS calendar was chock-full of "fika break" talks and opportunities. Kate and her spouse, Terry, look forward to many adventures by bike and camper van in retirement, and we wish them all the best–they've earned it!

Jean Riordan

After twenty years of dedicated service to the State of Alaska at the Geologic Materials Center, Jean retired at the end of 2023. After earning her BS in geology at Northern Illinois University in 1983, Jean worked with the Defense Mapping Agency in St. Louis, Missouri, and as a database administrator for the USGS Pacific Marine Geology section in Menlo Park, California. She eventually made her way to Alaska and worked as a freelance videographer before landing at the GMC when it was located at the Eagle River facility. Before the relocation to Anchorage, she was often seen during the winter in her purple North Face puffy snow-blowing paths to the sixty connexes that housed geologic samples. In 2015, she became Assistant Curator and was instrumental to the successful move to the new facility in Anchorage and the development of the GMC's database that is in use today. A three-time nominee for the Governor's Denali Peak Performance Award, Jean was always happy to assist clients at the GMC and even helped establish a paleontological repository for fossils found on National Park land in Alaska. In retirement, Jean returned to Illinois and is looking forward to spending time with family and traveling. We wish you all the best in retirement, Jean. You will be missed!



Hugh "Huey" Winston

Huey joined the division's Geologic Information Center as an analyst/programmer in mid-2023. He came to DGGS from the Department of Health after earning his MS in statistics from UAF in 2022. While here, he was critical for implementing technology improvements to the Community Snow Observations program (communitysnowobs.org) and in the development of GIS tools used by the division to plan aerial surveys. Huey left DGGS in the winter of 2024 to return to the Department of Health as a research analyst working on statistics. We wish him luck in all his career goals!

Michelle Gavel

Michelle first joined DGGS as a summer intern for the Energy Resources Section in 2018. After the summer field season wound down, she returned to New Mexico State University to finish her MS, completing a thesis studying extensional tectonics using low-temperature thermochronology in 2019. After graduating she returned to DGGS to work with the Engineering Geology Section (now Hydrology & Surficial Geology Section) on the ASTAR project. In 2021, Michelle moved into a permanent geologist 2 position with the Mineral Resources where she was responsible for managing the section's GIS databases to support geologic mapping. She also set up digital data collection applications for the mapping team to use in the field and took on the role of U-Pb geochronologist for the section and made multiple trips to the Arizona LaserChron Center to analyze our samples.

Michelle is an easy-going, fun field partner who brings levity to rainy field days, brushy traverses, and frigid lunch-time winter bike rides. Her distinctive pink camo pistol holster perfectly encapsulates her fun-loving and hard-working demeanor. A helicopter pilot once described her as "tough," a moniker she proved by competing in multiple ultra-endurance bike rides. In spring 2024, Michelle followed her spouse and two cats back to New Mexico and has since worked for the New Mexico Bureau of Geology & Mineral Resources in environmental services. We wish her the best in her future career!

Alaska Division of Geological & Geophysical Surveys

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