Alaska Division of Geological & Geophysical Surveys

ANNUAL REPORT 2023

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. DGGS geologist Conner Truskowski collects data for the Haines STATEMAP project outside Skagway, Alaska in August 2023.

Back. DGGS geologist Mort Larsen maps surficial and glacial deposits in the Takshanuk Mountains above the Haines Highway. 2023 fieldwork in this area supported the Haines STATEMAP project.

STATE OF ALASKA
Mike Dunleavy, Governor

DEPARTMENT OF NATURAL RESOURCES
John Boyle, Commissioner

DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS
Melanie Werdon, State Geologist and Director

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MESSAGE FROM THE DIRECTOR

It is a privilege to be writing this message and sharing with you all the wonderful accomplishments achieved by the Division of Geological & Geophysical Surveys (DGGS) in the past year. After former Director David LePain retired in June 2023, I proudly agreed to serve as acting director until the position could be permanently filled. Tragically, after leading the division for only 15 days, our survey learned of a helicopter crash in the Arctic Coastal Plain of Northwest Alaska, likely involving three of our DGGS family members and the pilot. After addressing the challenges associated with logistics and their remote location, emergency responders finally confirmed the devastating fear that DGGS geologists Ronnie Daanen, Justin Germann, and Tori Moore, as well as pilot Tony Higdon, had been killed in the accident on July 20, 2023.

Not only were the three of them bright, respected geologists, but they had wonderful stories and experiences that made them quite unique. Ronnie was a gifted ice carver, submitting many entries into the state's world ice art competition; his knowledge and love of plants was impressive. Justin, a former National Guard member, was one of a small group of people to have traveled the infamous 300-mile snow and ice road known as the Community Winter Access Trail. Tori was eager to learn and fit in well with her upbeat personality. She quickly gained the respect of her fellow co-workers and was known for her unselfish help. She found it hilarious when she learned that Fairbanks doesn't celebrate July 4 at night…well, because there really isn't one.

We will miss these DGGS family members with all our hearts, and our sincere condolences go out to the family and friends of our fallen companions, including those of Mr. Higdon. Our closely knit and genuine staff are still healing from the event, and we are doing everything we can to learn from it…to grow stronger as a division, and build upon an already resolute safety culture which helps anchor our daily decisions and optimistic attitudes.

Current, timely geologic information is critical for public safety, resource exploration, emergency management, scientific research, land management, and development. Regardless of the amount of information gathered, the distribution of that knowledge to those who need it is key to providing the desired outcome. Our survey responded to a record-breaking 3,721 requests for geologic information in 2023, which were driven by increased interest in, and DGGS response to, geologic hazards, requests for publications and online datasets, and renewed inquiries to the Geologic Materials Center about available samples, tax credit seismic data, and sample donation offers. I encourage you to take in and learn about how our division benefits the State of Alaska; you will no doubt be filled with awe by all the amazing projects and critical work highlighted in this year's report.

On December 11, 2023, Melanie Werdon officially became the next DGGS director and state geologist, the first woman to fill that role. Melanie's extensive experience and many years with the survey will certainly be an advantage as she leads us into the future. Congratulations, Melanie!

Respectfully,

Kenneth R. Papp
Acting Director and State Geologist (July – December 2023)

REMEMBERING OUR COLLEAGUES

A Tribute to Ronald Daanen, Justin Germann, and Tori Moore

Ronald “Ronnie” Daanen, Justin Germann, and Tori Moore passed away tragically during a helicopter crash while conducting fieldwork in the Arctic Coastal Plain of Northwest Alaska on July 23, 2023, along with their pilot, Tony Higdon. They each made significant contributions to DGGS in unique ways and in this annual report, we want to memorialize their contributions.

Ronnie was the program manager for the division’s Hydrology Program. He was known for his multidisciplinary work both in Alaska and internationally, collaborating with countless people within DGGS, state and federal agencies, academia, and private industry. Ronnie’s projects included evaluating changing permafrost and hydrology on the North Slope, where he collaborated closely with UAF research groups and contributed to the ASTAR project evaluating hydrology along a proposed road corridor between the communities of Atqasuk and Utqiagvik.

One of Ronnie’s primary work focuses was helping to evaluate and understand unstable slopes. For over 10 years he was involved with investigations of frozen debris lobes in the southern Brooks Range that threaten the Dalton Highway and the Trans-Alaska Pipeline System. He would visit these features multiple times a year with colleague Margaret Darrow (UAF) to collect data to better understand how they move. He also helped evaluate unstable slopes around the state, including Haines, Barry Arm, and Sitka, where landslide hazards threaten lives and infrastructure. This work often involved the collection and evaluation of hydrometeorological and remote sensing data and designing, installing, and maintaining environmental monitoring systems to collect data vital for hazard assessments.

Much of Ronnie’s work directly impacted those in Fairbanks. For example, he helped develop a landslide inventory for Fairbanks, as part of a collaborative project with UAF, and map discontinuous permafrost in the Goldstream Valley using geophysics.

During his 11 years at DGGS, Ronnie authored 46 DGGS publications and numerous other external publications, attesting to his significant impact to the scientific community.

Justin Germann joined DGGS as a long-term non-permanent hydrologist 2 in 2022 to help with the ASTAR project. During the summer of 2022, he helped install weather stations and measure stream discharge to better understand hydrology along the proposed corridor. In early 2023, Justin helped develop an automated data-processing platform for many of DGGS's environmental and geotechnical monitoring sites. In addition to publishing this data, he also presented some of his findings at the Alaska section of the American Water Resource Association in Anchorage in March 2023.

In the spring of 2023, Justin was hired as a hydrologist 3 for DGGS to help launch a new Renewable Energy Program. Collaborating with Ronnie, Justin had begun developing project ideas and was writing proposals to seek funding for in-river hydrology project work.

Tori Moore started work with DGGS in June 2023 as a short-term non-permanent geologist 1 with the ASTAR project. She was tasked with helping prepare for and participate in fieldwork in Point Lay to help collect construction material resource information. Her enthusiasm and propensity for being detail-oriented was most welcome at the division. Tori had begun to help populate the ASTAR reference database and was excited to learn about ArcGIS and the geology of the North Slope. When the hydrology group needed help with fieldwork between Atqasuk, Utqiagvik, and Wainwright to install and maintain stream gauging and weather stations, Tori was eager to help and gain valuable experience. Despite being with DGGS for only a short time, Tori was an important member of our agency and had expressed interest in continuing with DGGS at the end of her temporary position.

While Ronnie, Justin, and Tori made meaningful contributions to the geologic and scientific communities, they will be primarily missed and remembered for their kindness, senses of humor, and contributions to the DGGS and their communities.

ORGANIZATION

Melanie Werdon
Director & Chief Geologist

Ken Papp
Division Operations Manager

Admin

Sonja Zastrow
Admin Officer II

- **Felisa Childsdress** — *Admin Assistant III*
- **Liz Sjoblom** — *Admin Assistant II*
- **Theresa Harmon** — *Accounting Tech II*
- **Jess Thurman** — *Admin Assistant I (LTNP)*
- **Kelsey Ward** — *Grants Administrator*

Energy Resources

Marwan Wartes
Section Chief Geologist V

- **Josh Long** — *Petroleum Geologist I*
- **Trystan Herriott** — *Geological Scientist I*
- **Bob Gillis** — *Geologist IV*
- **Nina Harun** — *Geologist II*

Geologic Materials Center

Kurt Johnson
Curator Geologist V

- **Jean Riordan** — *Geologist IV*
- **Kaleb Smith** — *Geologist I/II*
- **Andy Ethington** — *Nat Res Tech II (LTNP)*
- **Gabrielle Efird** — *College Intern*
- **Alex Garcia** — *College Intern*
- **Xianghui Zeng** — *College Intern*

Alaska Geospatial Office

Leslie Jones
Large Project Coordinator

Mineral Resources

Evan Twelker
Acting Section Chief Geologist IV

- **Rainer Newberry** — *Geo Scientist I (LTNP)*
- **Abraham Emond** — *Geologist IV*
- **Michelle Gavel** — *Geologist II*
- **Chris Wyatt** — *Geologist II*
- **Logan Fusso** — *Geologist IV*
- **Alicja Wypych** — *Geologist IV*
- **Travis Naibert** — *Geologist III*
- **Dave Szumigala** — *Geologist IV (LTNP)*
- **Wes Buchanan** — *Geologist I*
- **Michael Barrera** — *College Intern*

Volcanology

Cheryl Cameron
Section Chief Geologist V

- **Abigail Nastan** — *Geologist II*
- **Scott Crass** — *Analyst/Programmer IV*
- **Kate Bull** — *Geologist III*
- **Lee Zirnheld** — *Geologist II*
- **Dain Harmon** — *Analyst/Prog III (LTNP)*
- **Janet Schaefer** — *Geologist IV (STNP)*

Geologic Information Center

Mike Hendricks
Section Chief GIS Analyst IV

- **Chris Ramey** — *Data Processing Mgr I*
- **Hugh Winston** — *Analyst/Programmer III*
- **Oralee Nudson** — *Systems Programmer II*
- **Tommy Folan** — *Analyst/Programmer III*
- **Tom Cerny** — *Microcomputer Tech I*
- **Simone Montayne** — *Geologist III*
- **Sue Seitz** — *Analyst/Programmer IV*
- **Allie Steinleitner** — *GIS Analyst II*
- **Amy Macpherson** — *GIS Analyst III*
- **Pedro Rivera** — *GIS Analyst III (LTNP)*
- **Kristen Janssen** — *Publication Spec II*

Hydrology & Surficial Geology

Trent Hubbard
Section Chief Geologist V

- **Robin Carbaugh** — *Geologist II (LTNP)*
- **Jenna Zechmann** — *GIS Analyst II*
- **Marlee Haralson** — *Geologist III (LTNP)*
- **Sandra Walser** — *Geologist I*

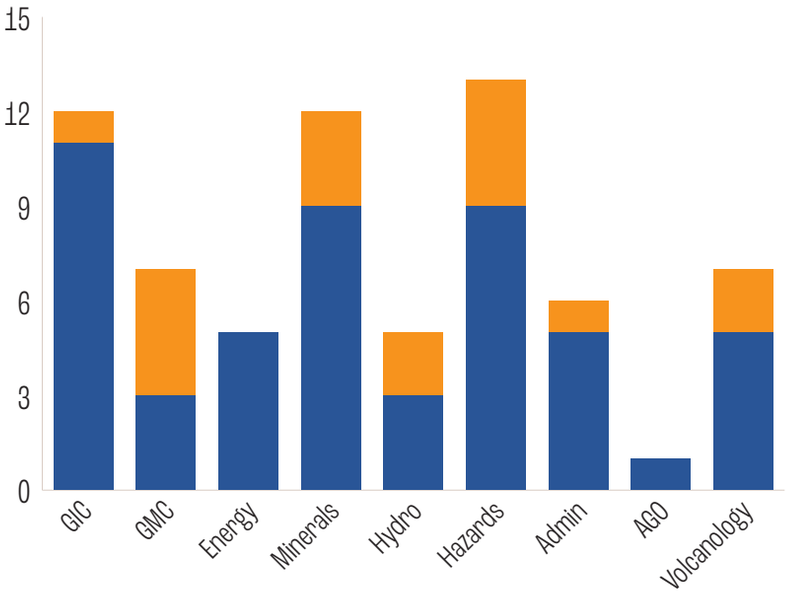
Geologic Hazards

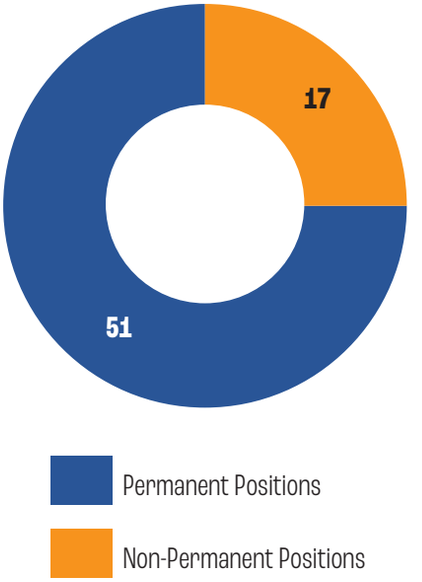
Jen Athey
Section Chief Geologist V

- **Barrett Salisbury** — *Geologist IV*
- **Gabriel Wolken** — *Geological Scientist I*
- **Katreen Wikstrom Jones** — *Nat Res Specialist III*
- **Mort Larsen** — *Geologist IV*
- **Jill Nicolazzo** — *Geologist III*
- **Conner Truskowski** — *Geologist II (LTNP)*
- **Paul Goodfellow** — *Env Prog Spec IV*
- **Alison Woodward** — *Nat Res Tech II (LTNP)*
- **Nora Nieminski** — *Geologist IV*
- **Autumn Poisson** — *Geologist III*
- **Keith Horen** — *GIS Analyst II (LTNP)*
- **Jessie Christian** — *Geologist II (LTNP)*

...BY THE NUMBERS

Division Staff



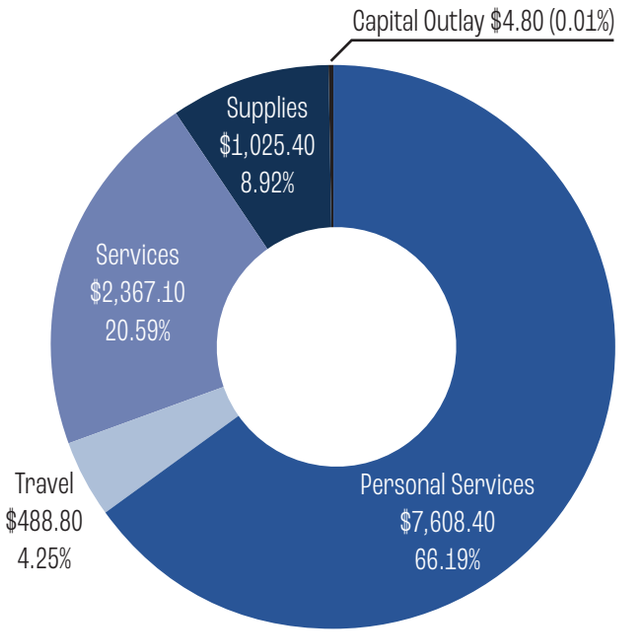


Budget

FY23 Authorized Budget

$11,494.50

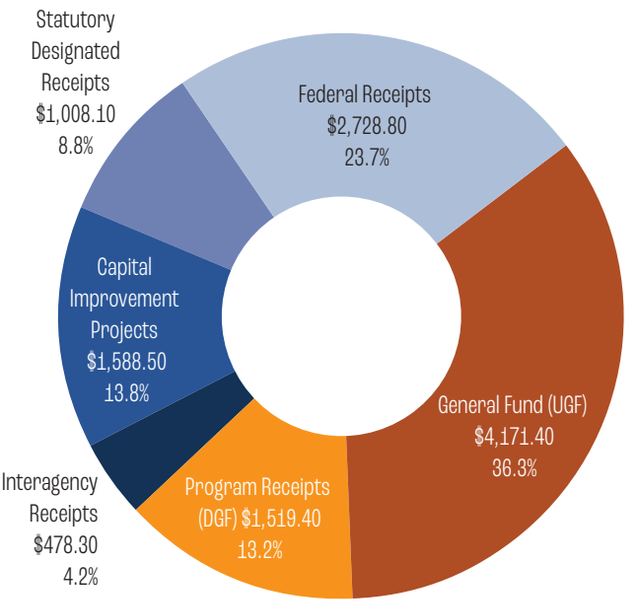
Total Budget (in thousands of dollars)



FY23 Funding Sources

$11,494.50

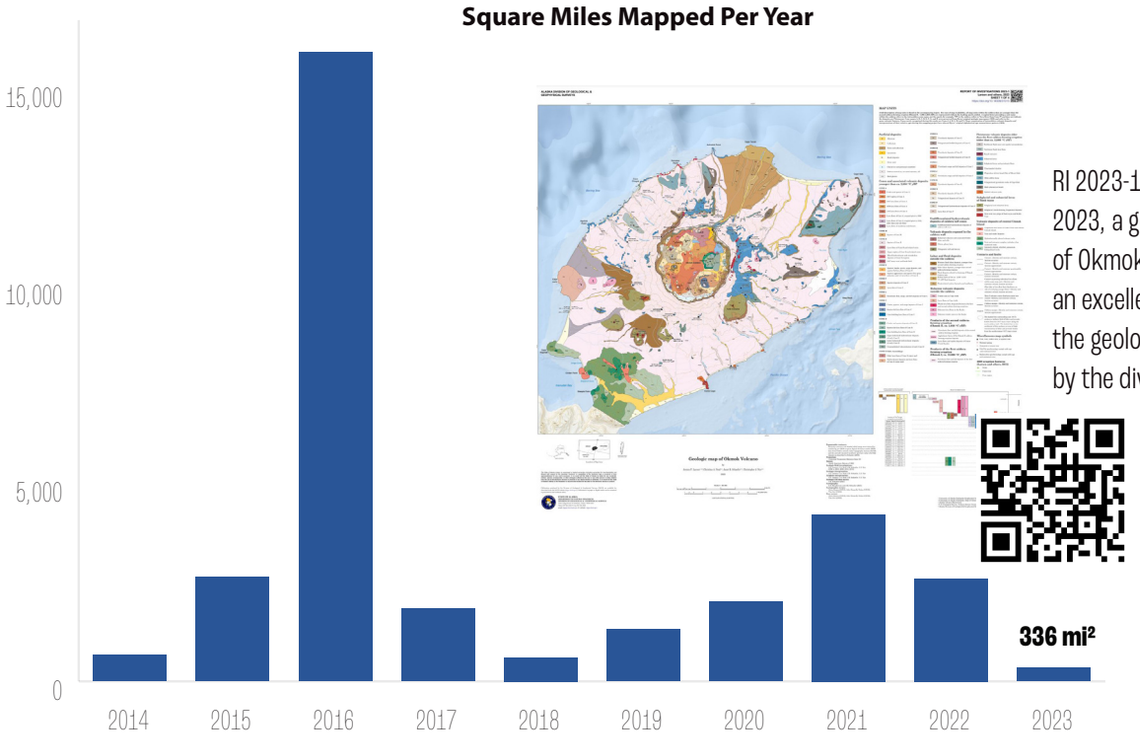
Total Budget (in thousands of dollars)



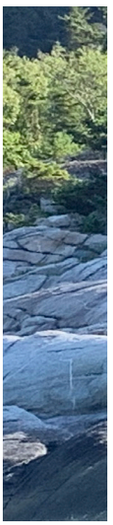
...BY THE NUMBERS

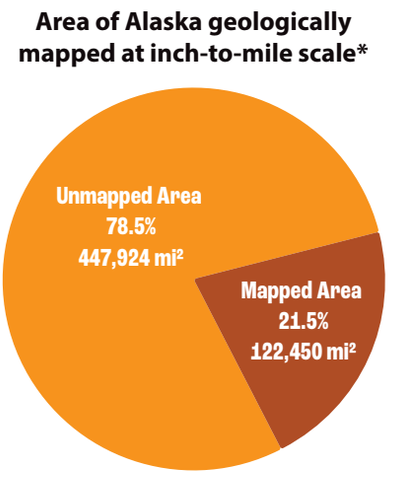
Geologic Mapping

Detailed geological and geophysical maps of Alaska at scales needed for resource exploration, land-use management, and geologic-hazards assessment are currently available for 21.5 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 FY2023 DGGS published geologic mapping for a total of 336 mi^2 of Alaskan lands. **Over the past 10 years, DGGS has published an annual average of 3,218 mi^2 of peer-reviewed geologic mapping.**



RI 2023-1, published in 2023, a geologic map of Okmok Volcano, is an excellent example of the geologic work done by the division.

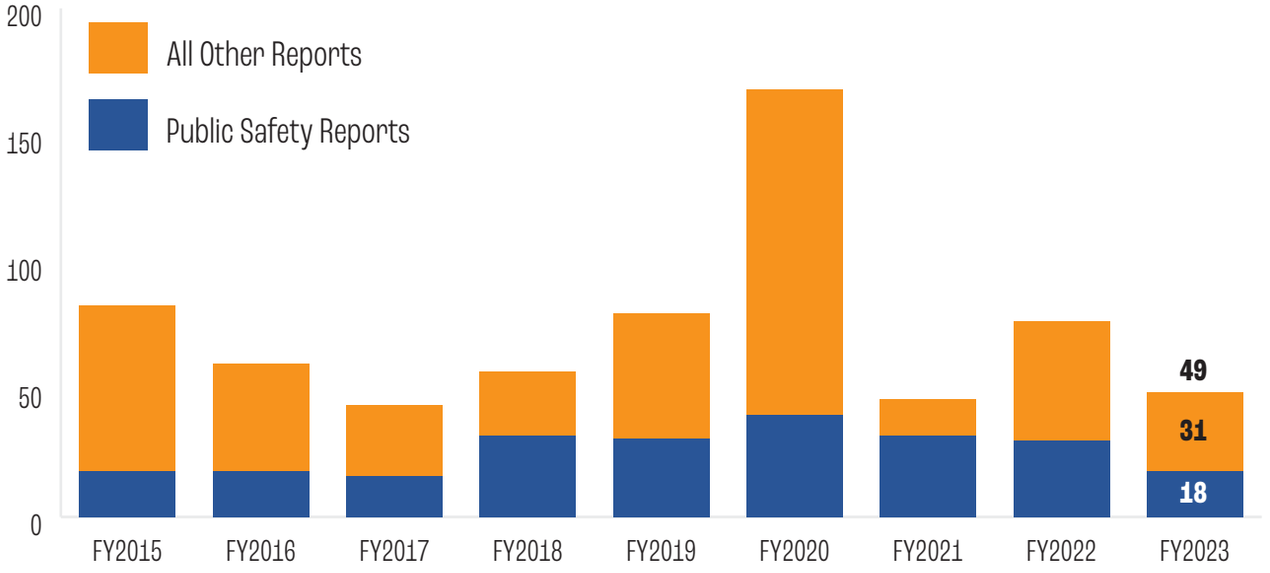




*Total Alaska land area: 570,374 mi^2

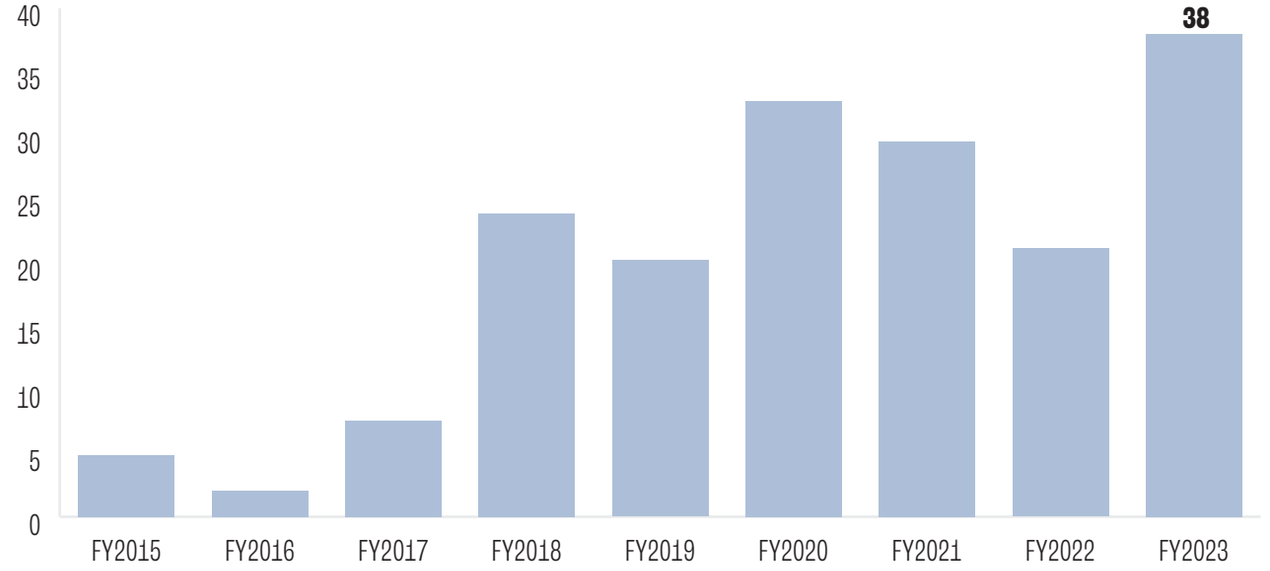
...BY THE NUMBERS

Publications Distributed*



**These numbers do not reflect the 2023 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


Josh Long


Nina Harun

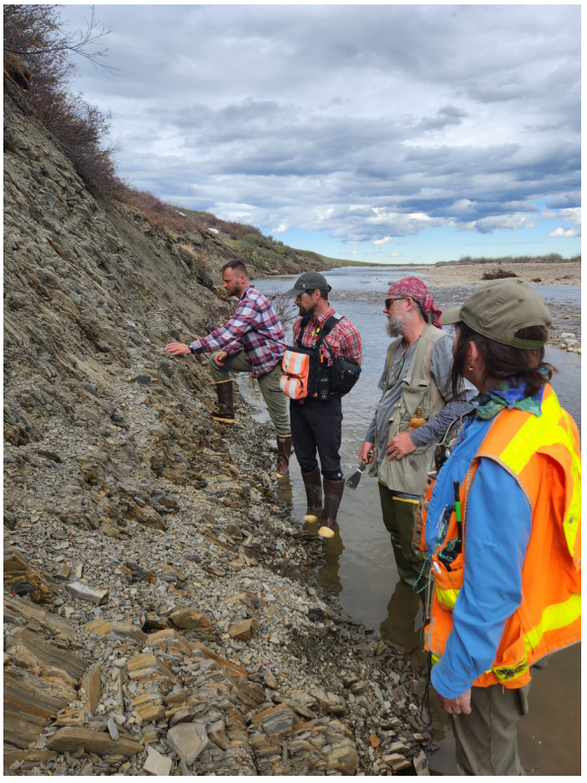

Trystan Herriott

The Energy Resources Section generates new geologic information about Alaska's oil, natural gas, coal, and geothermal 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 potential.

FIELDWORK

Applied energy research in northern Alaska is supported by the U.S. Geological Survey (USGS) STATEMAP program, the State of Alaska, and our long-running industry-supported Sponsor's Program. In June and July, Energy Resources geologists conducted 25 days of helicopter-supported fieldwork on the central North Slope, including a new geologic mapping effort 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.

Energy Resources conducted new geologic mapping efforts on the central North Slope.



Collaborating with the Geologic Information Center (GIC), we continue to modernize and improve data collection using tablets and various software in the field. With the help of colleagues at the Texas Bureau of Economic Geology, we added to our collection of high-resolution GigaPan images and drone-based photogrammetry of important outcrops. These data aid in visualization and quantitative assessment of potential reservoir geometries; efforts are underway to distribute this digital data in a format that can be used by industry in reservoir modeling.

Fieldwork was also conducted in the Matanuska Valley area as part of the section's 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 shares many features with Cook Inlet and is prospective for oil and gas.

STRATIGRAPHIC TEST CORES

During the summer, we initiated field operations for a major collaborative project with the USGS to drill two stratigraphic test cores on the North Slope. The effort strategically targeted important Brookian source and reservoir intervals. Unfortunately, technical and mechanical difficulties limited the amount of core that was collected, resulting in the extension of the drilling campaign into summer 2024. Aspects of this work are supported 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 the Hydrology & Surficial Geology Section for more information about the ASTAR Project).

DGGS collaborated with USGS geologists to drill two test cores on the North Slope targeting Brookian source and reservoir intervals.

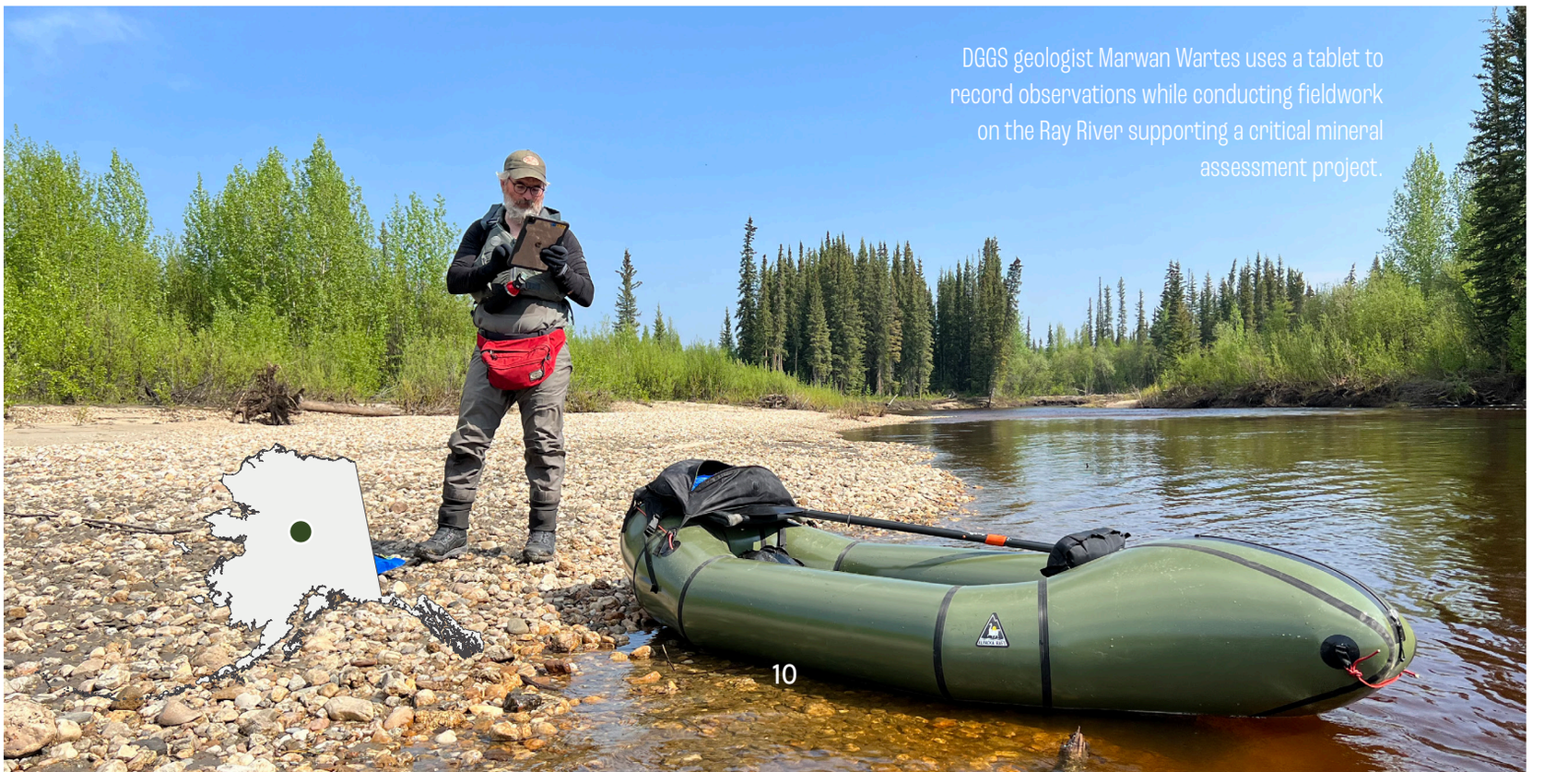
UNCONVENTIONAL CRITICAL MINERALS

DGGS is co-leading an effort with the University of Alaska to assess Alaska's potential to provide critical minerals, including rare earth elements, 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 U.S. Department of Energy and includes a diverse team of private and Native corporation partners. Work is underway to screen cores at the Geologic Materials Center in Anchorage with a specialized handheld X-Ray Fluorescence instrument capable of characterizing low-concentration rare earth elements such as lanthanum and cerium. Preliminary data from the Usibelli Coal Mine (a project partner) demonstrate that some high-ash coals and other associated strata contain sufficient critical mineral content to warrant further study. The project also held a successful two-day meeting in September at the University of Alaska Fairbanks that brought together various stakeholders interested in the establishment of a critical minerals industry in Alaska.

DATA DISTRIBUTION AND PUBLICATIONS

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 appropriate 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 work, we published an important measured section as well as a summary of the controls on Nanushuk reservoir quality.



DGGS geologist Marwan Wartes uses a tablet to record observations while conducting fieldwork on the Ray River supporting a critical mineral assessment project.

Progress was also made on geologic maps, including the submission of a completed deliverable draft map and cross section for the Racetrack Basin area on the central North Slope to the USGS STATEMAP program. This map includes a number of important outcrops of the Nanushuk Formation. Final publication of this map awaits integration of seismic data in collaboration with USGS colleagues.

DGGS also co-chaired an oral session on techniques for precisely dating sedimentary rocks at the annual meeting of the Geological Society of America in Pittsburgh, Pennsylvania. This gathering brought together diverse experts and included a well-received presentation from DGGS on our latest applied research on the geology of northern Alaska.

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 the Alaska Range and Matanuska Valley 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 recent DGGS report. This type of work is building the framework needed to explore in areas with oil and gas potential but limited available subsurface data.

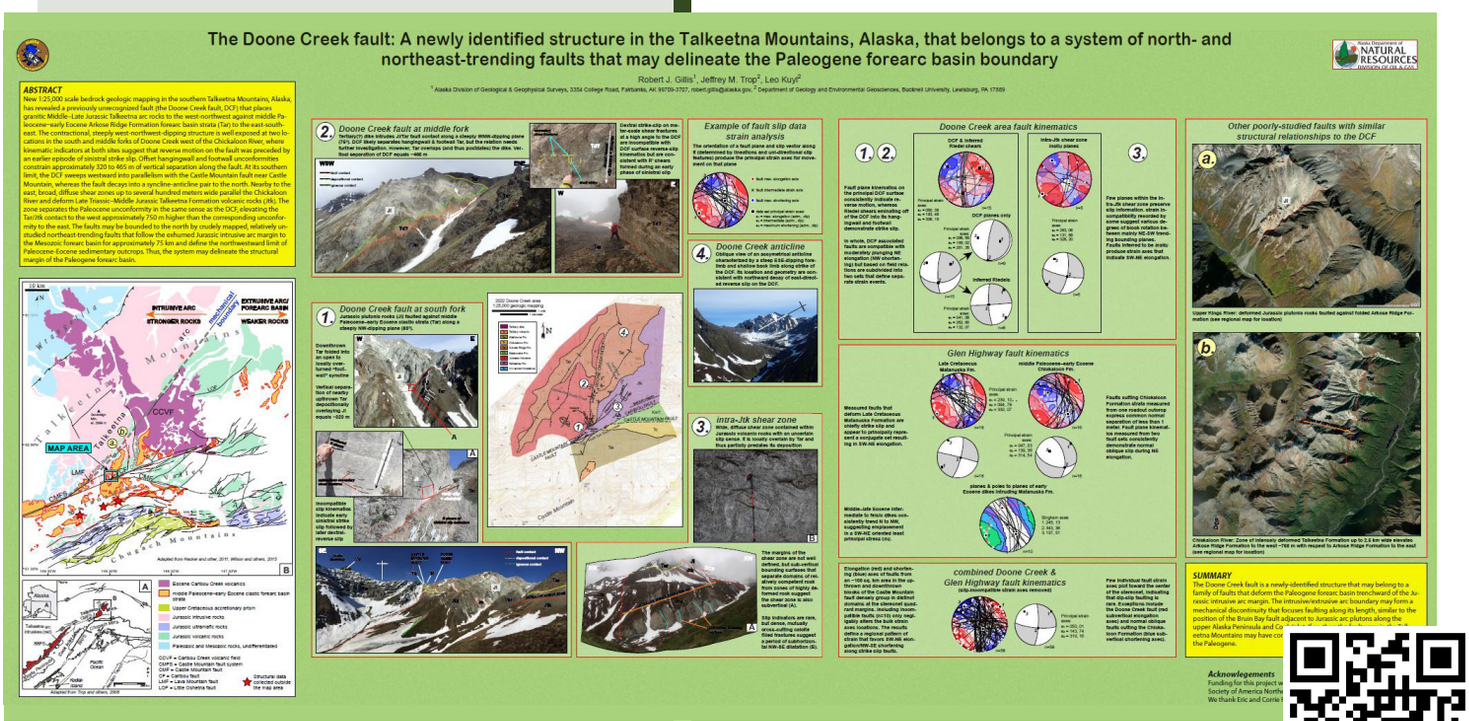
Select Energy Resources Section 2023 Presentations

doi.org/10.14509/31023

The Doone Creek fault: A newly identified structure in the Talkeetna Mountains, Alaska, that belongs to a system of north- and northeast-trending faults that may delineate the Paleogene forearc basin boundary (poster): Alaska Geological Society Technical Conference, Anchorage, Alaska, April 22, 2023

doi.org/10.14509/31038

Controls on reservoir quality of the Nanushuk Formation (Albian-Cenomanian), North Slope, Alaska (poster): Alaska Geological Society Technical Conference, Anchorage, Alaska, April 22, 2023



Highlight

Alaska's Geothermal Energy Potential—Is the Future Now?

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. These data are critical for resource identification and risk reduction, both of

Sample collection at remote Tatlawiksuk Hot Springs. Photo: Tom Bundtzen.

Scan or click to visit the Geothermal Sites of Alaska Web App

which attract industry to invest in exploration and development and create the environment for economic growth.

Promising news from around the state indicates this potential may be harnessed in the future, including:

- Project development and financing continue for the large Makushin geothermal project near the community of Unalaska in the Aleutians. This clean energy could power the planned seafood processing plant nearby, which is poised to be the largest in North America.
- The Alaska Division of Oil & Gas has issued geothermal prospecting permits at two volcanoes in Cook Inlet: Augustine Island and Mount Spurr. In addition, the agency announced plans to hold a competitive lease sale at Mount Spurr, which may accelerate exploration activity. Geothermal energy from this region could eventually fill the predicted shortfall of natural gas in Southcentral Alaska.
- The U.S. Department of Energy announced the selection of two projects in Alaska as part of its effort to fund community-led geothermal solutions. The city of Seward will design a district heat system utilizing geothermal heat pump technology to provide hot water to various municipal buildings. The other project will support the development of a direct-use geothermal system at Pilgrim Hot Springs, approximately 60 miles from Nome on the Seward Peninsula.

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.

Mount Spurr (top) and Augustine Volcano (bottom), both located in Cook Inlet, are the subject of prospecting permits granted by the Alaska Division of Oil & Gas.

MINERAL RESOURCES


Evan Twelker


Abraham Emond


Michelle Gavel


Dave Szumigala


Wes Buchanan


Travis Naibert


Logan Fusso


Rainer Newberry

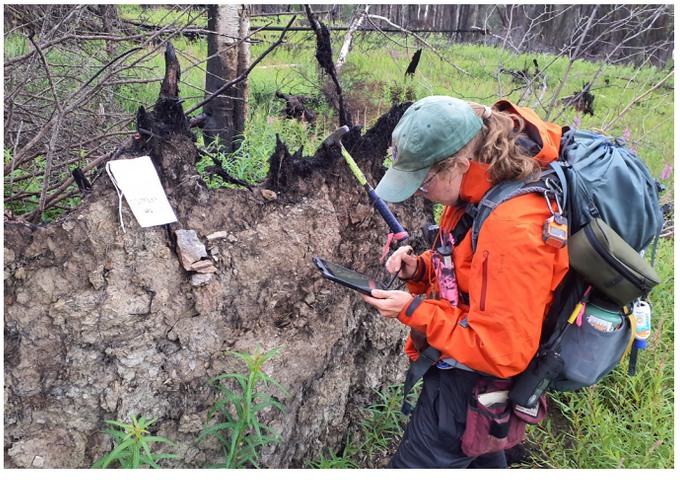

Chris Wyatt

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.

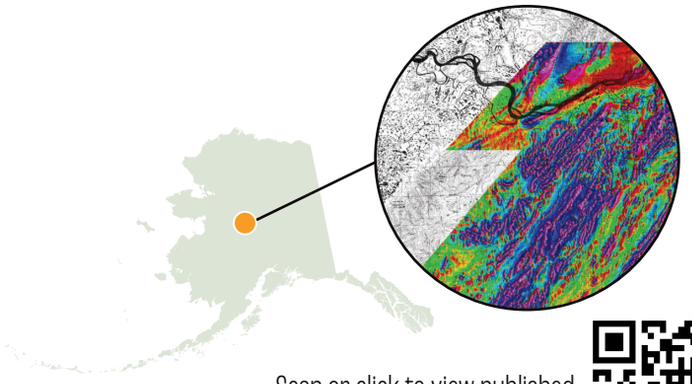
DGGS participates in the USGS's Earth Mapping Resources Initiative (Earth MRI), a critical-minerals-focused cooperative program to increase the nation's mineral security through geophysical surveys, geologic mapping, and geochemical analyses. This primarily federally funded project, supplemented with state matching funds, allows DGGS Mineral Resources geologists to create and disseminate geophysical and geological map products. These types of products have historically been shown to stimulate mineral industry interest, claim staking, and exploration activity in Alaska, as well as increase revenue to the state. The Earth MRI project is being implemented in cooperation with the USGS and is expected to be a 10-year national program (which started in 2019) funded at greater than $10 million per year. The USGS received an additional 5-year $70 million annual increase through the Infrastructure Investment and Jobs Act (IIJA) bill. In federal FY2023, Alaska received $5.8 million in federal funds under this program.

GEOPHYSICAL SURVEYING

DGGS geophysical contractors had a busy summer in 2023. Following the completion of the Yukon-Tanana Upland aeromagnetic survey block in 2022, the Earth MRI program focus shifted to the Kuskokwim mineral belt, a broad area of prospective geology lying between Manley Hot Springs, McGrath, Bethel, and Dillingham. The belt includes deposits such as Donlin Gold,



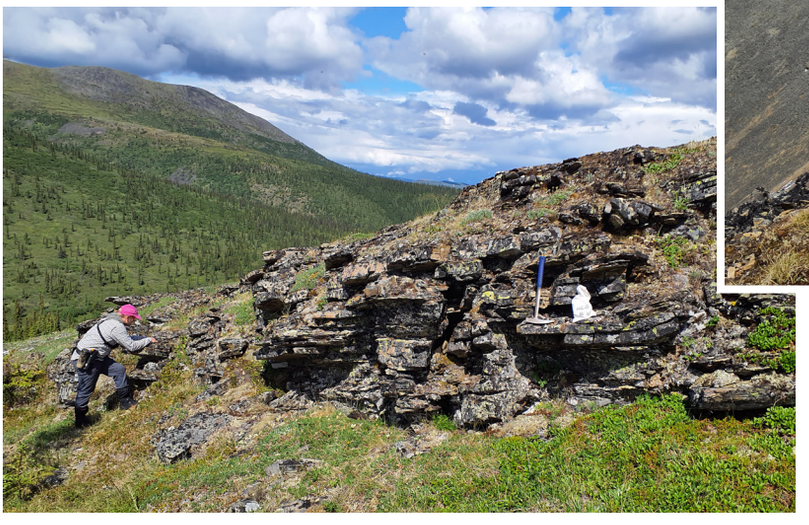
Mineral Resources geologist Michelle Gavel uses a tablet to record observations in the field.



Scan or click to view published geophysical data for the northern Kuskokwim Mountains

Nixon Fork, and Illinois Creek, as well as prospects including Sleitat, Shotgun, Vinasale, Nyac, Colorado Creek, and many others. Increased funding enabled DGGS to begin surveying the northeast end of this belt with two contractors: a fixed-wing aircraft flying the lower topography and a helicopter flying the more rugged terrain. This high-quality dataset, which we anticipate will take three years to collect, will benefit Alaska for decades to come. The first published results are available at doi.org/10.14509/31087.

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.



GEOLOGIC MAPPING

DGGS Mineral Resources geologists continued their multi-year Yukon-Tanana Upland geologic mapping campaign, fielding 15 geologists for 505 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, supplemented by IIJA appropriations and a State of Alaska Capital Improvement Project. Earth MRI mapping projects are now funded on a three-year cycle, so that each map area receives two summers of fieldwork and one final year of map production. Multiple projects run concurrently.

The 2023 field program finalized the Mount Harper project area north of Delta Junction, which began in 2022. The crew began work on the Chena geologic mapping project, an area east of Fairbanks and north of Delta Junction that includes the Pogo gold mine and nearby prospects, as well as base metal prospects of the Chena Slate Belt and

This year Mineral Resources geologists conducted 505 person-days of fieldwork supporting the Earth MRI-funded Yukon-Tanana Upland mapping project.

tungsten prospects of the upper Salcha River. The second phase of fieldwork will take place in 2024, followed by map publication in 2025.

As part of the Earth MRI program, DGGS selected ~4,000 historical USGS stream-sediment pulps from across the Yukon-Tanana Upland for re-analysis with modern techniques, including a full suite of elements. The published data is 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.alaska.gov/maps-data/interactive-maps.html.

ALASKA MINERAL INDUSTRY REPORT

The Mineral Resources Section is in the process of finalizing Alaska's Mineral Industry 2021 report as well as gathering data for 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.

Mineral Resources 2023 Publications

RDF 2023-6 | doi.org/10.14509/30963

Field station locations and magnetic susceptibility data collected in 2022 for the Mount Harper project, Eagle, Big Delta, and Mount Hayes quadrangles, Alaska

RDF 2023-15 | doi.org/10.14509/31016

Zircon U-Pb results from the eastern Moran area, Tanana B-6 and Melozitna B-1 quadrangles, Alaska

RDF 2023-23 | doi.org/10.14509/31085

$^{40}Ar/^{39}Ar$ geochronology data from the Tanacross and Eagle quadrangles, Alaska

RDF 2023-24 | doi.org/10.14509/31089

Geochemical data from samples collected in 2022 for the Mount Harper geologic mapping project, Big Delta, Mount Hayes, and Eagle quadrangles, Alaska

RDF 2023-27 | doi.org/10.14509/31096

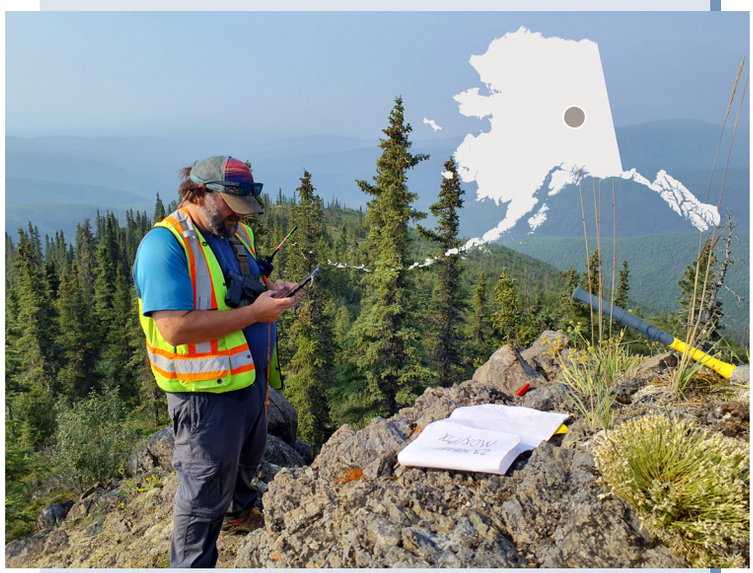
Field station locations and magnetic susceptibility data for the Chena-Pogo and Mount Harper projects, Big Delta and Circle quadrangles, Alaska, collected June-September 2023

PIR 2023-2 | doi.org/10.14509/31013

U-Pb zircon geochronology of bedrock samples collected in the Eagle and Tanacross quadrangles, eastern Alaska

GPR 2023-1 | doi.org/10.14509/31087

Kuskokwim airborne magnetic and radiometric geophysical survey, northern Kuskokwim Mountains



Highlight

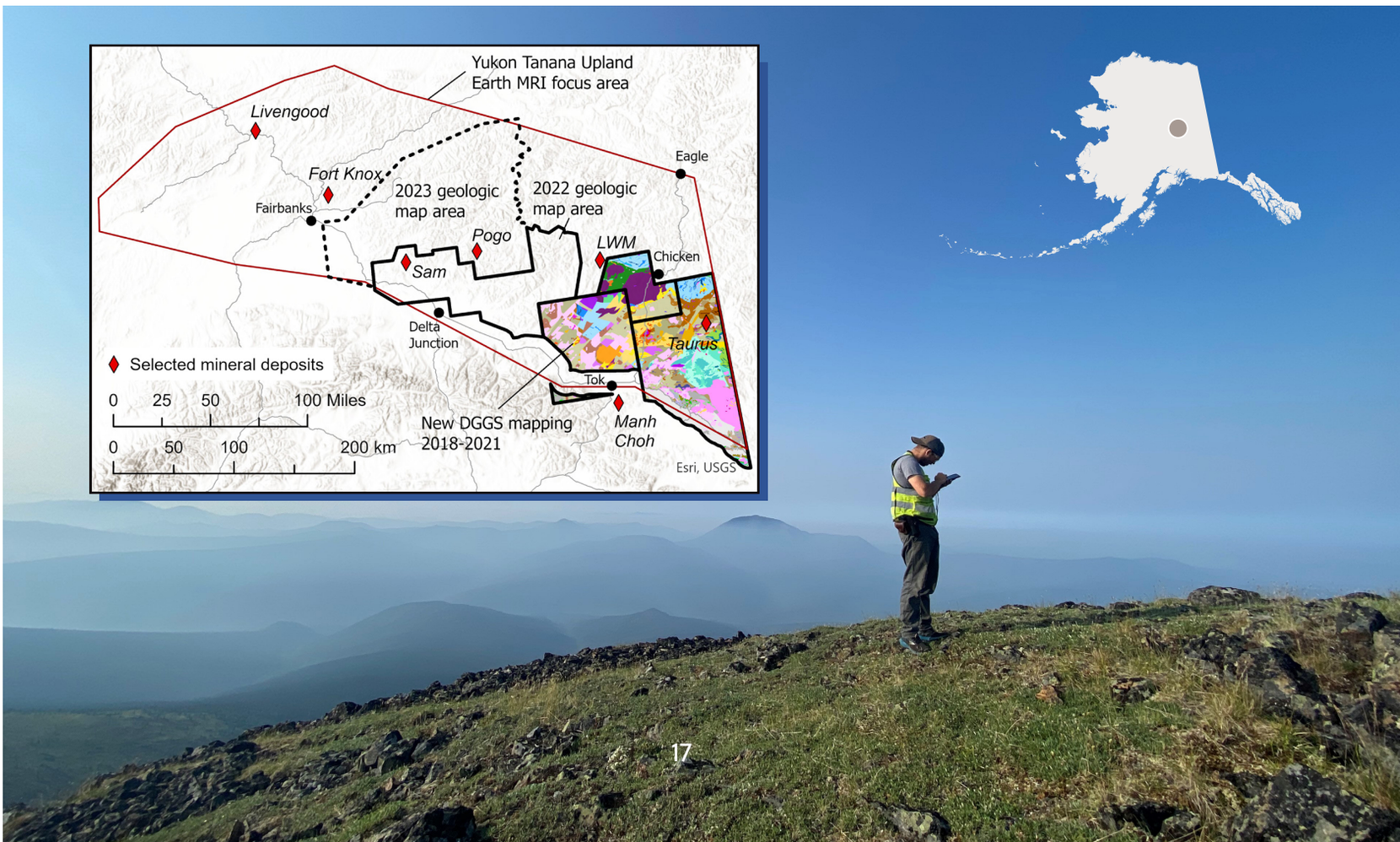
Mapping the Yukon-Tanana Upland

Alaska's Yukon-Tanana Upland (YTU), the region in the Interior between the Tanana and Yukon rivers, is a vital center for Alaska's mining industry. The region's rich historical placer mines and currently operating large hard-rock mines have produced 24 million ounces of gold; an additional 32 million ounces have been discovered but not yet mined. Gold in the region may have brought mining to the Interior and founded Alaska's second-largest city, Fairbanks, but the YTU also has high potential for critical minerals—high-tech metals essential to modern life and often sourced from outside the United States. These include tin, tungsten, antimony, bismuth, tellurium, rhenium, and rare earth elements.

While the YTU is resource-rich, its geology is not as well understood as it needs to be. Prior to 2019, large areas had only widely spaced, pre-GPS geophysical surveying, "reconnaissance" geologic mapping with insufficient levels of detail to guide industry exploration, and numerous "semi-quantitative" geochemical analyses with no measurements of many important critical minerals.

At the direction of DGGS's Geologic Mapping Advisory Board, the Mineral Resources Section has been upgrading these three key geoscience datasets (geophysical data, geologic mapping, and geochemical analyses) for the YTU through Earth MRI. When Alaska received an influx of additional Bipartisan Infrastructure Law funding through Earth MRI, DGGS geologists rose to the challenge by mapping larger areas without sacrificing data quality; the 2023 program logged more than 500 person-days in the field, a 10 percent increase over the 2022 program.

DGGS also marked an important milestone in 2022 when it completed airborne magnetic coverage of the YTU. When the geological and geochemical datasets are completed for the region, scientists and exploration companies will have modern, detailed, and internally consistent geoscience datasets from which to understand the mineral-resource potential and make new mineral discoveries in Interior Alaska.



HYDROLOGY & SURFICIAL GEOLOGY


Trent Hubbard
Section Chief


Marlee Haralson

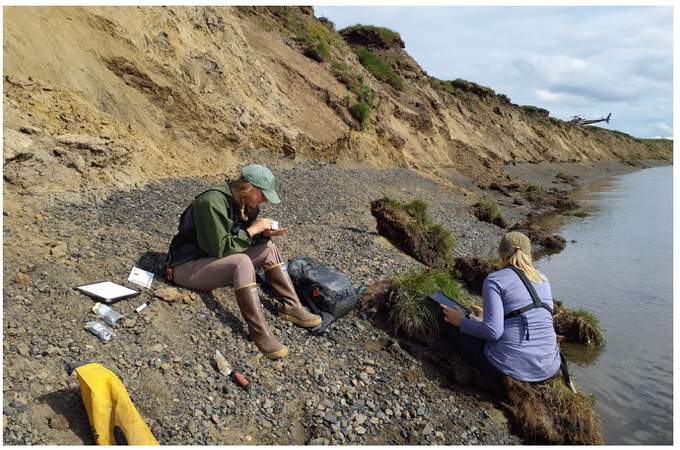

Robin Carbaugh


Sandra Walser


Jenna Zechmann

The Hydrology & Surficial Geology Section includes programs focused on hydrology, surficial geology, and lidar (light detection and ranging) data collection and processing. The projects within these programs often involve collaborative efforts with scientists from other sections as well as external organizations. Lidar products, hydrologic data and expertise, and surficial geologic mapping enhance our understanding of geologic hazards such as landslides, active faulting, and coastal erosion. Consequently, we collaborate closely with the Geologic Hazards Section. Surficial geologic mapping programs like the Arctic Strategic Transportation and Resources (ASTAR) program rely on collaboration and building relationships with other state and federal agencies, regional and local governments, tribal and Indigenous organizations, academic institutions, and non-profit organizations, to name a few. Data and expertise from our program provide essential information for long-term planning and infrastructure development projects.

ASTAR geologists collect data near Point Lay during 2023 summer fieldwork.



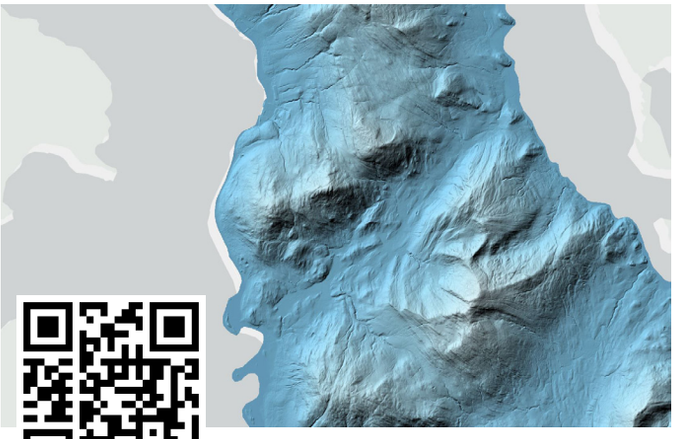
MAPPING WITH LIDAR

The Hydrology & Surficial Geology Section continues to leverage the power of lidar elevation mapping in response to strategic mapping priorities across the state. In just a few hours of flying, our system can collect many square miles of centimeter-accurate airborne survey information. High-resolution elevation data, often over multiple time epochs, is essential to assess geologic hazards and interpret landscape features.

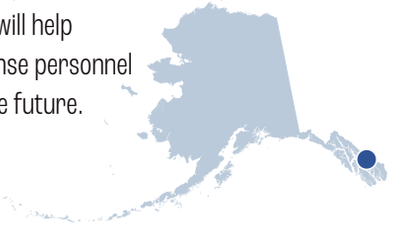
This year, we collected ~378 square miles of lidar data to support hazard assessments, avalanche studies, and hydrologic investigations. We collected, processed, and published 218 square miles of lidar data collected in July on Wrangell Island as part of a partnership with the U.S. Forest Service. Following the devastating November 20, 2023, Wrangell landslide, we collected and processed an additional ~15.5 square miles focused on areas where landslides impacted the community and infrastructure. Utilizing both datasets was extremely important for quickly evaluating landscape change, the volume of displaced material, and the potential for additional slope instability.

We also collected other lidar datasets to support ongoing multi-program hazard assessments. These included areas near the Barry Arm landslide to support slope stability investigations; near Cordova and Blackerby subdivisions in Juneau to support avalanche studies; and the Goodwin Glacier area.

In addition to collecting and processing new lidar, we continued to process and publish previously collected data. This included processing lidar data that will support upcoming geologic mapping and hazard assessments for a STATEMAP project on the north side of Cook Inlet. This year, we published datasets previously collected for the Twentymile River watershed, the Grewingk Glacier in Southcentral Alaska, and the Kipnuk, Kwigillingok, and Tuntutuliak areas in the Yukon Kuskokwim Delta.



Top. The November 2023 landslide in Wrangell sadly took six lives and blocked access south of the Zimovia Highway. **Bottom.** Lidar data collected in July (scan or click QR code), and post-slide (to be published in 2024) will help researchers and emergency response personnel study the event and prepare for the future.



HYDROLOGY

The Hydrology Program has been working on a wide range of water-related projects, from landslides to permafrost degradation and road construction. These projects contribute to understanding the hydrologic effects on hazards, such as the effect of construction on flooding or the impact of permafrost on groundwater, river runoff, and flooding behavior.

The program is building the capacity to observe changes in groundwater behavior in steep terrain. This includes helping on projects with the Climate and Cryosphere Hazards Program, the Landslide Hazards Program, the USGS, and other partners who study landslide dynamics, such as at Barry Arm landslide. Work also continued in Sitka and Haines, where recent landslides have devastated those communities; work in Haines included developing the ability to share data in real-time.

We continued work with the Alyeska Pipeline Service Company and University of Alaska Fairbanks (UAF) to study Frozen Debris Lobe A (FDL-A): a slow-moving ice, soil, and rock mass that forced the state to move the Dalton Highway and threatens the Trans-Alaska Pipeline System. This work included participating in ongoing efforts to better define the movement characteristics of FDL-A by evaluating borehole data and soil movement sensors and monitoring surface movement using existing sensors.

Hydrologic studies continued between Atqasuk, Wainwright, and Utqiagvik as part of the ASTAR project. These studies are helping to gather critical information for a potential road connecting the communities. We completed a snow depth survey near Atqasuk to help us better understand the hydrologic balance and water available for runoff. We also continued work to construct and maintain stream gauge sites and weather observation stations in the understudied region of the northwest Arctic. For this work, we transported over 5,000 lbs of gear to Atqasuk on the community winter access trail (CWAT), saving money on freight costs.

The Hydrology Program works on a wide range of water-related projects and collaborates with colleagues in and out of DGGS to further our understanding of the hydrologic effects on hazards.

An important component of work this year was installing repeater stations to facilitate real-time data monitoring capabilities. As a result of the tragic helicopter crash in July 2023, we could not complete this work, but we hope to continue it in 2024. Publications from the ASTAR work include profile and discharge data collected during the 2022 field season, as well as sonar and seismic lake survey data collected during 2021 fieldwork.

The program continued to assess permafrost change as part of a multi-disciplinary research team partially funded by the National Science Foundation; collaborative partners included UAF faculty who assisted with hydrologic studies of ice-rich Arctic tundra soils near Prudhoe Bay as well as producing lidar data.

A major milestone of the program was the launch of our Renewable Energy Program within the Hydrology Program. We hired Justin Germann to help with this effort, who began to seek funding opportunities and identify focus areas, but this work was unfortunately put on hold because of the tragic helicopter crash. We intend to relaunch our efforts in 2024.

GEOLOGIC MAPPING

ASTAR

This year, the Surficial Geology Program focused on construction materials mapping on the North Slope as part of the ASTAR project's sand and gravel resource assessment. This project aims to support communities and stakeholders by providing information about sand and gravel resources. An important project objective is to provide information supporting community needs and infrastructure opportunities and enhancing the region's quality of life. This starts by communicating with the people who live there to understand their needs.

Throughout the year, we met with community and regional stakeholders and gave presentations to the North Slope Borough, as well as the Port Authority and the Planning Commission. We also met with several communities, including regional

ASTAR's 2023 fieldwork focused on approximately 990 square miles near Point Lay where geologists visited 101 sites to collect samples and make observations.

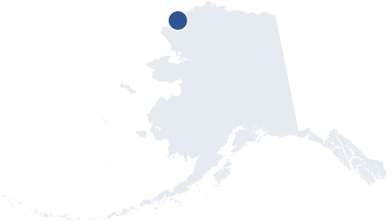
and local Native organizations, to update them on our progress. During our field season, we met with the Point Lay community members and leaders to build relationships, seek input, learn about community concerns, and inform them about ASTAR project objectives and plans. In November, we conducted a half-day workshop at UAF, where we gave a comprehensive summary of our project work to date for ASTAR stakeholders and the public.

In early 2023, we completed a final report for the Bureau of Land Management summarizing our findings from field data collection and resource assessments in the National Petroleum Reserve Alaska (NPR-A) for the AK NPR-A Resource Inventory and Database Development Grant, which helps support program work within the NPR-A.

This year's project work included the publication of field station and sample data descriptions associated with data collected between Atqasuk, Utqiagvik, and Wainwright in the summers of 2021 and 2022. We also continued developing material resource maps derived from terrain unit analysis, field data, and other available datasets.

DGGS geologists met with community members in Point Lay at an outreach event.

During the summer, our fieldwork focused on collecting data for an area of ~990 square miles near Point Lay. We visited 101 sites where we made observations of outcrops and surface landforms and used a small power auger to drill holes 10–15 feet deep. We described and characterized surface and near-subsurface materials and collected 201 samples for more detailed description and analysis following the field season. Field station data and sample descriptions are nearly ready to submit for publication. Our fieldwork also included collecting 387 active layer depth



Left. ASTAR geologists Sandra Walser and Robin Carbaugh traverse permafrost-rich tundra near Point Lay on the North Slope.
Right. ASTAR geologists Marlee Haralson and Robin Carbaugh display samples collected. The white board is used to display important data related to the sample, like the sample label and date collected.

Select Hydrology & Surficial Geology 2023 Publications

RDF 2023-1 | doi.org/10.14509/30954

Sonar and seismic lake surveys along the proposed triangle road corridor, northwestern Alaska, collected July 6–13, 2021

RDF 2023-3 | doi.org/10.14509/30959

Lidar-derived elevation data for the Twentymile River watershed, Southcentral Alaska, collected August–October 2022

RDF 2023-4 | doi.org/10.14509/30961

2021 Arctic Strategic Transportation and Resources (ASTAR) project field station location data and descriptions: Wainwright, Atqasuk, and Utqiagvik, North Slope, Alaska

RDF 2023-5 | doi.org/10.14509/30962

2021 Arctic Strategic Transportation and Resources (ASTAR) project field geotechnical data and sample descriptions: Wainwright, Atqasuk, and Utqiagvik, North Slope, Alaska

RDF 2023-13 | doi.org/10.14509/31011

2022 Arctic Strategic Transportation and Resources project (ASTAR) geotechnical data and sample descriptions: Utqiaġvik region (Barrow triangle), North Slope, Alaska

Left. The 2023 ASTAR field team visited 101 sites near Point Lay to make observations of outcrops and surface landforms and used a small power auger to drill holes 10–15 feet deep for sample collection. **Right.** DGGS geologist Robin Carbaugh analyzes one of the 201 samples collected for further investigation following fieldwork.

measurements and taking more than 3,000 photos to document field observations; the photos will be publicly available on the DGGS photo database.

In the fall, focus shifted to compiling and publishing field data collected during the summer. We are also developing plans to continue our community resource assessment in Anaktuvuk Pass in 2024.

North Central Tyonek Quadrangle Geologic Mapping

In the fall of 2023, DGGS began surficial geologic mapping as part of the 508-square-mile West Susitna STATEMAP project. This mapping project is funded through a State Capital Improvements Project grant along with matching federal funds and focuses on a proposed access corridor pursued by the Alaska Industrial Development and Export Authority (AIDEA). The proposed corridor would provide access to an area with potential mineral, oil, and gas resource exploration, forestry and timber harvesting, agricultural resources, alternative energy, and recreation interests for Alaskans. Detailed surficial mapping will inform proactive planning and mitigation in support of this proposed access corridor, providing information about construction material resources and geologic hazards, including active faulting. Work this fall has included compiling preexisting data and beginning preliminary desktop mapping in preparation for fieldwork in the summer of 2024.

GEOLOGIC HAZARDS

Jennifer Athey
Section Chief

KC Horen

Mort Larsen

Jill Nicolazzo

Nora Nleminski

Autumn Poisson

Barrett Salisbury

Conner Truskowski

Katreen Wikstrom Jones

Gabriel Wolken

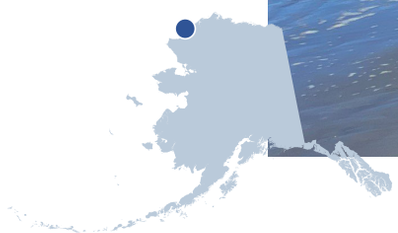
Allison Woodward

Jessie Christian

Paul Goodfellow

The Geologic Hazards Section is focused on geologic processes that threaten lives and infrastructure. The section features five programs that study and respond to hazards that impact Alaskans at a range of scales and intensities, from potential catastrophic damage to pressing local community concerns to the health of individual Alaska residents. The programs focus on specific geologic hazards as well as baseline data collection to support multi-program activities. The section also manages division-wide grants that support high-value geologic data preservation projects and a statewide geologic map compilation. Many projects require overlap between programs to boost scientific and technical expertise and maximize individual staff contributions. Each program is not only collaborative within the section but also maintains relationships with other state and federal agencies, regional and local governments, tribal and Indigenous organizations, academic institutions, non-profits, and others. Alaska is too big to do our work any other way.

Coastal Hazards Program staff member KC Horen collects profile data in Wainwright, Alaska.

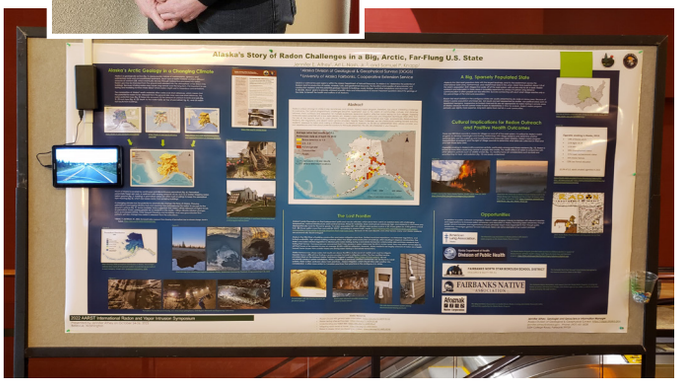


GEOLOGIC HEALTH HAZARDS PROGRAM

Naturally occurring radioactive radon gas is the leading cause of lung cancer among non-smokers and accounts for 21,000 deaths in the United States annually. Radon gas can concentrate inside buildings and is an under-recognized health risk in Alaska. DGGS manages the Alaska Radon Program with assistance from UAF's Cooperative Extension Service. The program is funded by the federal Environmental Protection Agency's (EPA) annual State and Tribal Indoor Radon Grant, which is issued to the Alaska Department of Environmental Conservation's (DEC) Division of Air Quality. The Alaska Radon Program provides education and outreach on radon to the public and organizations that work on housing and health issues. It also provides free home radon test kits during January for National Radon Action Month. The Alaska Radon Program directly provided radon information and (or) free radon tests to 920 Alaskans in FY2023 and educated, reached, or contacted an estimated 52,771 residents through events, press releases, and social media.

dggs.alaska.gov/hazards/radon.html

The winner of the third annual Alaska Radon Poster Contest submitted by Katelyn Cummings from Anchorage.



Left. Radon Specialist Allison Woodward helps distribute hundreds of radon tests during National Radon Action Month.
Below. The Alaska Radon Program poster at the fall 2022 AARST conference.

DGGS also provides geologic expertise to residents and other Alaska agencies on groundwater quality and naturally occurring asbestos. Poor groundwater quality in Alaska affects many homes and neighborhoods with private wells. This issue is not isolated to one region but is a concern throughout the state, on and off the road system. With EPA funding, DGGS is collecting groundwater quality data and creating statewide maps of natural contaminants like arsenic and nitrate. The project has developed an online tool, Be Well Informed, to help the public better understand water quality data that they receive from laboratories. DGGS had no active naturally occurring asbestos programs in FY2023.

COASTAL HAZARDS PROGRAM

The Coastal Hazards Program (CHP) continues to work collaboratively with state, federal, tribal, academic, public, and private institutions to map, monitor, and model flood and erosion hazards in Alaska's coastal communities. The CHP 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. In response to the 2019 Denali Commission Threat Assessment (which identified 187 communities that are impacted by one or more of the environmental threats of flooding, erosion, and permafrost degradation), 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. Additionally, the program collaborates with communities to maintain ongoing erosion and flood monitoring projects.

One of the CHP's primary activities is to produce flood risk assessments for environmentally threatened communities. Six community assessments have been published, and several more are planned for 2024 (dggs.alaska.gov/pubs/id/30573).

KC Horen collects data in Wainwright, Alaska.

The Coastal Hazards team in Utqiagvik. Left to right: KC Horen, Nora Nieminski, Autumn Poisson, and Jessie Christian.

This work is accomplished with funding support from the National Coastal Resilience Fund in partnership with the Alaska Native Tribal Health Consortium and aids in flood exposure mapping. The CHP also continues erosion monitoring with the assistance of community members using measuring tapes, measurement rods, and time-lapse cameras. To support this work in 2023, CHP staff visited Kongiganak, Tuntutuliak, Utqiagvik, Wainwright, Point Lay, Shishmaref, and Kivalina.

The CHP also helps coordinate the Alaska Water Level Watch through support from the Alaska Ocean Observing System program, which monitors flood events using photographic evidence of storms and a real-time water level sensor network (water-level-watch.portal.aoos.org). CHP staff help maintain and monitor eight water level sensors around the state to help close the gaps in the National Water Level Observation Network. As part of this effort, water level sensors were replaced by the CHP in Kwigillingok and Kipnuk.

Part of this year's CHP field campaign extended to the North Slope as part of the ASTAR project. The project supports communities and stakeholders by providing information about infrastructure opportunities and enhancing the region's quality of life (read more about ASTAR in the Hydrology & Surficial Geology Section). CHP's role in the project is to address the safety needs of North Slope communities that are experiencing increased risks related to coastal flooding and erosion. In addition to conducting fieldwork and data collection related to these risks, the CHP also aims to target wide audiences with its findings, with the goal of making data accessible and digestible. One example is this Esri StoryMap (QR code below; dggs.alaska.gov/pubs/id/31097) that illustrates event-driven erosion in Wainwright and summarizes the effectiveness of different erosion mitigation strategies.

Alaska remains at the forefront of national initiatives to map its shoreline and the nearshore. The CHP's efforts provide the opportunity to fill major data gaps for Alaska communities facing flood, erosion, and permafrost threats. We continue to develop and grow collaborative relationships and have submitted several new project proposals, which promise exciting future directions and opportunities. At its core, the CHP's goal is to work closely with each community to achieve what is most beneficial for them.

Coastal Hazards Program manager Nora Nieminski collects coastal data in Wainwright, Alaska. Scan or click the QR code to view an Esri StoryMap about the importance of data collection and community input in coastal Alaska.

CLIMATE AND CRYOSPHERE HAZARDS PROGRAM

The Climate and Cryosphere Hazards Program (CCHP) works with a diverse group of partners and local stakeholders to assess, monitor, and predict the impacts of a changing cryosphere on communities, infrastructure, and resources in Alaska. In 2023, we continued to facilitate and conduct actionable science in snow distribution, snow avalanche, and glacier- and permafrost-related hazards research and respond to geologic hazards affecting Alaskans.

During the winter of 2023, the CCHP continued snow distribution and snow avalanche research; conducting fieldwork, including aerial lidar surveys in multiple locations in Southcentral and Southeast Alaska; and working with partners from the USGS, Alaska Railroad Corporation, UAF, Alaska Energy Light & Power, Alaska DOT&PF, and Alaska Department of Fish and Game. Due to an extended winter season, our normal snow distribution surveying took place nearly a month later than originally planned. In late April and early May, we used aerial lidar techniques to map snow distribution near Juneau and in the Barry Arm fjord, gathering important metrics on snow water storage and natural and artificially generated (mitigation) snow avalanches following storm events. These metrics help to improve our understanding of landslide hydrology, validate the program's regional-scale snow avalanche simulation and mapping data, and improve the efficacy of mitigation efforts.

In 2023, the CCHP continued small- and large-scale snow avalanche modeling and mapping. We continued our study with partners from the Swiss Institute for Snow and Avalanche Research and the UAF Climate Adaptation Science Center to evaluate future changes in snow avalanches in Southeast Alaska and began a similar study focusing on the Municipality of Anchorage. In October, we presented five papers with collaborators on snow and avalanche research at the International Snow Science Workshop in Bend, Oregon.

Avalanches threaten people and infrastructure at Hiland Rd. Eagle River, AK March 25, 2022. Photo: Loren Holmes/ADN.

The Community Snow Observations project continues to deliver critical snowpack information to scientists and managers. This year, with help from crowdsourcing, we gathered and logged more snow observations in Alaska than ever before and developed the first near-real-time operational snow distribution product in Alaska (mountainsnow.org).

Changes in glaciers and mountain permafrost continue to be important topics for Alaska. We continue to monitor glacier-dammed lakes and glacial lake outburst floods in several locations in the state. In 2023, we continued our participation in the multi-agency effort to characterize, assess, and monitor the Barry Arm landslide (see Landslide Hazards Section). We also continue to work with partners on several other glacier-related landslide hazards in Alaska, including Portage Glacier, Maynard Mountain, Serpentine Glacier, and Columbia Glacier, and contribute to the ongoing Wrangell landslide response and event analysis.

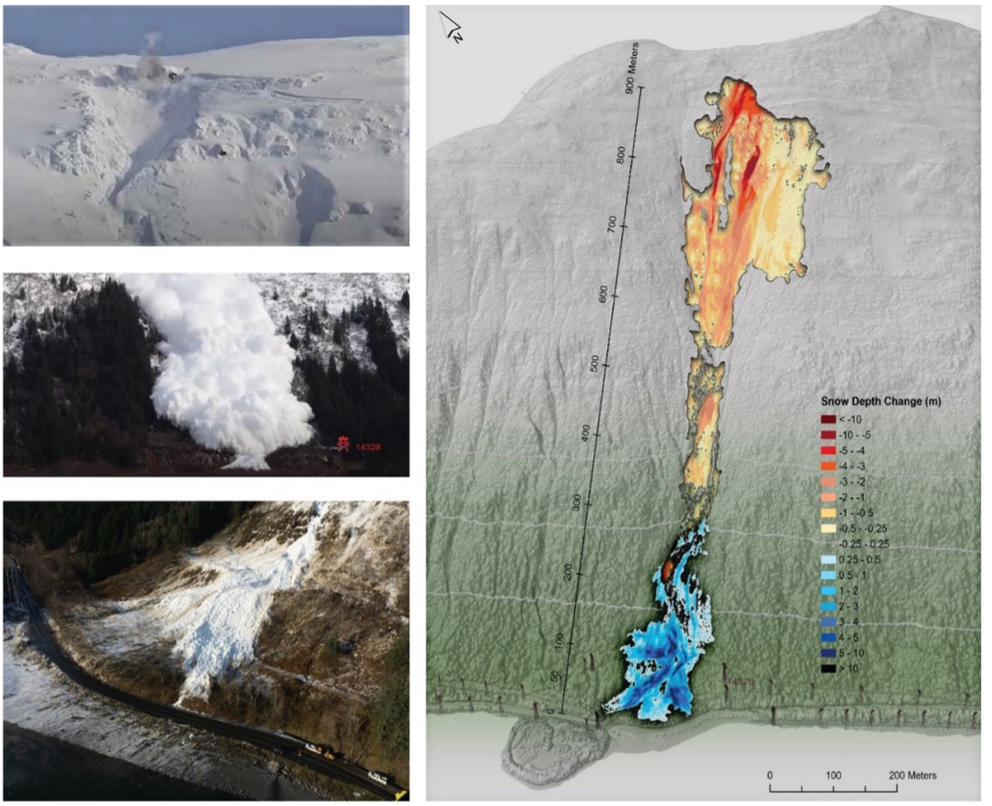
Highlight

Large-Scale Avalanche Hazard Assessments

Snow avalanches are dangerous natural hazards that occur in mountainous areas when snow decouples from a slope and flows downhill. In Alaska, snow avalanches are the deadliest natural hazard, and they affect a large portion of the state, significantly impacting the natural landscape, infrastructure, and public safety. Currently, there is limited public awareness and available information to support adaptation, mitigation, and preparedness efforts for these hazards, even in Alaska's most populated locations. As climate warming continues, the frequency and magnitude of snow- and ice-related hazards will change, and it is expected that Alaska's vulnerability to avalanche hazards will increase.

To address these challenges, the CCHP has been working with partners from the University of Alaska Fairbanks and the Swiss Institute for Snow and Avalanche Research on the development of an avalanche hazard mapping protocol suitable for Alaska's size, topographic and climatic diversity, and data constraints. With funding from the USGS Alaska Climate Adaptation Science Center, these techniques are being applied in Southeast Alaska and validated locally with detailed avalanche mapping and modeling in consultation with avalanche practitioners.

In 2022, following multiple avalanches impacting people and infrastructure in the Municipality of Anchorage (MOA), the CCHP and MOA discussed the urgent need to better understand avalanche hazards and improve stakeholder preparedness and community resilience. In 2023, the CCHP was awarded funding by the Federal Emergency Management Agency to assess snow avalanche hazards in the MOA. This four-year study will use high-quality snow and climate data, modern snow avalanche modeling techniques, and regionally developed approaches to update snow avalanche hazard maps and assess potential future changes in avalanches. Work on this project began in November 2023.



Left. Photo sequence of the March 4, 2021, avalanche in Juneau. **Right.** Lidar-derived snow depth change from March 3 to 4, 2021, showing areas of erosion (yellow-red) and deposition (blue).

Highlight

Alaska Hosts Workshop for National Geologic Map Makers

DGGS, in conjunction with the USGS National Geologic Map Database (NGMDB) and the Association of American State Geologists, hosted the annual Digital Mapping Techniques workshop in Anchorage in May 2023. The meeting brought together 70 scientists, cartographers, and GIS specialists from 29 state and federal agencies to exchange technical information and expertise. The Digital Mapping Techniques workshop (ngmdb.usgs.gov/Info/dmt/) is an annual series that focuses on collegial interaction to develop efficient and standardized methods for digital geologic mapping, publication, and GIS analyses. The digital mapping techniques, standards, and guidelines then govern the format of geologic map deliverables for federal grants and drive data requirements for regional and national geologic initiatives.

The NGMDB, the primary organizer of the workshop and part of the USGS National Cooperative Geologic Mapping Program, is stipulated to be a national archive of geoscience maps, reports, and data that is developed according to a set of technical and science standards as defined by the NGMDB and partner agencies. NGMDB hosts a number of public tools, such as the Map Catalog (ngmdb.usgs.gov/ngm-bin/ngm_compsearch.pl) of United States geologic publications from 600 publishers and the geologic map image database, MapView (ngmdb.usgs.gov/mapview). DGGS publications are provided to the NGMDB for inclusion in both databases, and these tools provide another public access point to DGGS's geologic information. NGMDB now also receives and quality controls geologic map deliverables for the federal STATEMAP, NGGDPP, and Earth MRI grant programs that continue to fund DGGS's geologic mapping projects.

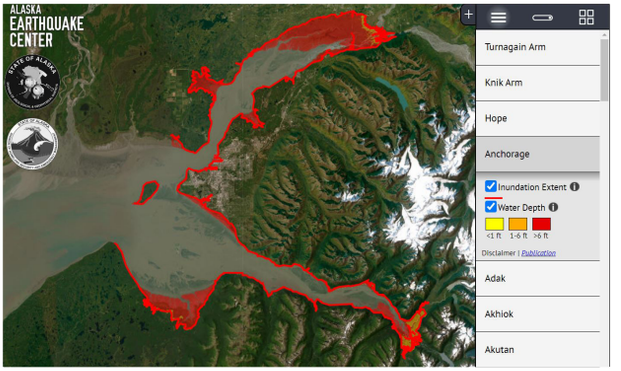
DGGS has been attending and presenting at Digital Mapping Techniques workshops for more than 25 years. We have also been active participants in the creation of the national geologic mapping standards currently implemented across state and federal geologic offices. Moreover, DGGS has mandated the use of these standards in our own office and developed robust operating procedures and products around them (see the Geologic Information Center section for more information). At the 2023 workshop, DGGS presented on four topics:

- The publications and distribution process at Alaska DGGS (doi.org/10.14509/31021)
- Contracting out geologic map digitization and attribution using the GeMS standard, Version 2.0 (doi.org/10.14509/31017)
- Lessons learned from developing a multi-map geologic database (doi.org/10.14509/31020)
- Developing, maintaining, and publishing documentation standards (doi.org/10.14509/31022)

EARTHQUAKE AND TSUNAMI HAZARDS PROGRAM

The Earthquake & Tsunami Hazards Program at DGGS is focused on reducing the impact of future earthquakes and earthquake-induced geohazards like tsunami events and slope failures. A major component of this effort involves working directly with Alaskans—emergency management, law enforcement, community officials, and residents—to help them become more resilient in the face of ever-present geohazards through education, planning, mitigation, and response. Fundamental to resilience is hazard assessment, and DGGS continues to assess relative seismic and tsunami hazards posed to communities, statewide infrastructure, and planned future projects. DGGS collaborates on the state, federal, and international levels to advance the understanding of neotectonics in Alaska and to increase seismic resilience in the Arctic and Subarctic in the face of a changing climate.

DGGS 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 (seismic.alaska.gov). Earthquake & Tsunami Hazards Program manager Barrett Salisbury represents DNR and is the current chair of the commission. This year, the commission received additional National Earthquake Hazard Reduction Program funds to continue a multi-year effort to improve building code adoption and enforcement in Alaska.



Top Right. This online, interactive tool allows the public to view and download published tsunami inundation data: earthquake.alaska.edu/sites/default/eqMap2/tsunami/html/tsunami.html.
Top Left. DGGS and UAF staff often travel to different communities throughout the state to educate the public and local officials about tsunami risks and hazards. This photo is from a trip to Whittier.
Bottom. Elena Suleimani (UAF) gives a talk in Seldovia.

Highlight

Understanding potential impacts from tsunamis in upper Cook Inlet

DGGS manages the DNR portion of the federally funded National Tsunami Hazard Mitigation Program (NTHMP), increasing earthquake and tsunami hazard awareness across the state with partners at the Alaska Earthquake Center and the Alaska Division of Homeland Security & Emergency Management. Ongoing NTHMP work with at-risk Alaska communities was recently featured in Undark Magazine (undark.org/2023/11/27/alaska-tsunami/), highlighting some of the unique challenges like earthquake- and landslide-induced tsunamis, complex coastlines, and variable warning systems that are a part of everyday emergency preparedness in Alaska.

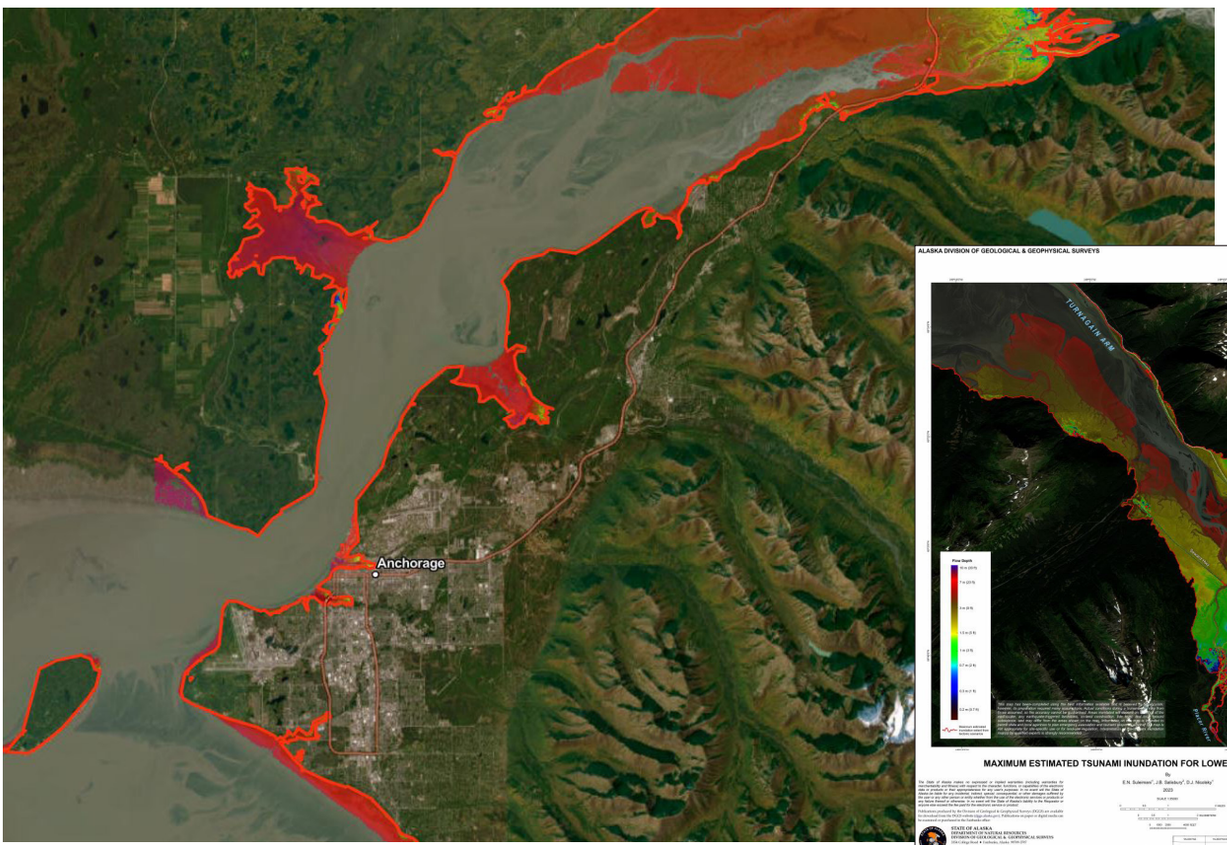
Working closely with the Alaska NTHMP group, DGGS published inundation maps and reports depicting areas that could be affected by future potential tsunami events in Anchorage and upper Cook Inlet (dggs.alaska.gov/pubs/id/31018). **This area, once thought to be completely immune from tsunami impacts because of the long, shallow inlet separating Anchorage from the open ocean, had never been assessed for tsunami hazards.** The lack of tsunami observations in Anchorage after the 1964 M9.2 Great Alaska Earthquake gave residents a false sense of security. As part of our study, we re-analyzed the complex interaction between the extreme tides in upper Cook Inlet and the 1964 earthquake-generated ocean disturbance to show that a tsunami did indeed reach upper Cook Inlet in 1964—it just arrived in the middle of the night and on an extremely low tide, minimizing any impacts. Our modeling results of potential future tsunamis show

Turnagain Arm, just south of Anchorage, has the largest tidal range in the United States, with a difference of nearly 30 feet between high and low tide.

that if a **worst-case scenario earthquake occurs at the correct time in the tidal cycle, then the incoming tide plus tsunami event could cause up to about 10 meters of inundation** in low-lying areas in upper Cook Inlet several hours after the initial earthquake. **The majority of Anchorage residential areas would be out of harm's way, but the Port of Alaska and other infrastructure near the high tide line could be impacted.**

The details of our study are available in an ArcGIS StoryMap (storymaps.arcgis.com/stories/c146aa74a3694059b4c0e5db33559a49) and were discussed in Science Magazine (www.science.org/content/article/folks-alaska-should-take-seriously-anchorage-not-safe-tsunamis-study-finds). Understanding the potential future impacts from earthquakes and tsunamis in upper Cook Inlet is crucial to long-term infrastructure resilience planning, emergency response, and personal education. Recent tsunami alerts in the Anchorage area—alerts not followed by actual tsunami events—have caused considerable confusion about who needs to evacuate and to where. We now know which folks in low-lying areas should be concerned after the next significant earthquake, and the next step is educating Alaskans to make informed decisions. Check your local inundation zones at tsunami.alaska.edu.

> **Our revised understanding of the confluence of conditions in upper Cook Inlet that led to an unnoticed tsunami in 1964 helps us prepare for the rare but real possibility of a destructive tsunami reaching Anchorage.**
>
> *—Elena Suleimani, Tsunami Modeler, Alaska Earthquake Center*



LANDSLIDE HAZARDS PROGRAM

The Alaska Landslide Hazards Program (ALHP) advances our knowledge of concepts and considerations for areas affected by steep terrain and unstable slopes, assesses the potential risk from landslide hazards, and provides expertise and guidance during a landslide/mass wasting event. We work closely with federal entities and other DGGS programs on new and ongoing projects to evaluate unstable slopes across the state. Funding from a Cooperative Agreement with the USGS has been an integral part of the Barry Arm and Prince William Sound monitoring and research program over the past few years, and this year the program has expanded to include Southeast Alaska. This year we laid the groundwork for the Alaska Landslide Inventory (ALI). ALI is designed to compile, consolidate, continuously update, and distribute to the public landslide information and will be integrated with the U.S. Landslide Inventory database (www.usgs.gov/tools/us-landslide-inventory). ALI will be populated with ongoing and completed landslide studies and data from other sources. It will also provide landslide-related information to the public through an online interactive map and data portal.

This year we conducted surficial mapping and sample collection for geotechnical analysis for the Haines USGS STATEMAP project. These results will be integrated into our on-going Haines Federal Emergency Management Agency (FEMA) Cooperative Technical Partnership Program (CTP) project that was initiated shortly after the fatal 2020 landslide. Our work will result in landslide susceptibility and inventory maps for the Haines Borough, to be published in 2024. These maps and report—which

In November, a fatal landslide occurred in Wrangell, claiming six lives. DGGS geologists, as well as many other agencies, responded immediately after it occurred and continue to study the event.

will be used as a template for future analyses in other high-risk communities in the state—will assist communities with decision-making regarding future development and education for areas that may be prone to landslide activity. Wrangell recently experienced a devastating landslide; while the community continues to recover, research has only just begun. In 2024, we will propose a FEMA CTP project for the City and Borough of Wrangell to address the need for mapping and identifying vulnerable slopes and terrain.

The ALHP and CCHP received funding from the USGS to purchase two full weather stations, along with supporting equipment and supplies, that can be deployed at high-elevation locations in Southeast Alaska. This will expand the weather station network in Alaska; provide additional hydrometeorological data to be used in landslide research, early warning system development, and outreach the for the ALHP; and strengthen the formal, long-term partnership between the USGS and DGGS.

Landslide Hazards Program geologist Jill Nicolazzo views the Beach Road landslide in Haines while conducting field work to support the USGS STATEMAP project.

VOLCANOLOGY

FIELD OPERATIONS

The Volcanology Section is part of the multi-agency Alaska Volcano Observatory (AVO). AVO's primary objective is to conduct monitoring and scientific investigations to assess the nature, timing, and likelihood of volcanic activity in Alaska. Knowledge of particular volcanic systems, combined with operational monitoring that includes satellite remote sensing, seismology, infrasound, gas emissions, and ground deformation allows AVO to assess volcanic risk and provide timely and accurate information about impending hazardous volcanic activity.

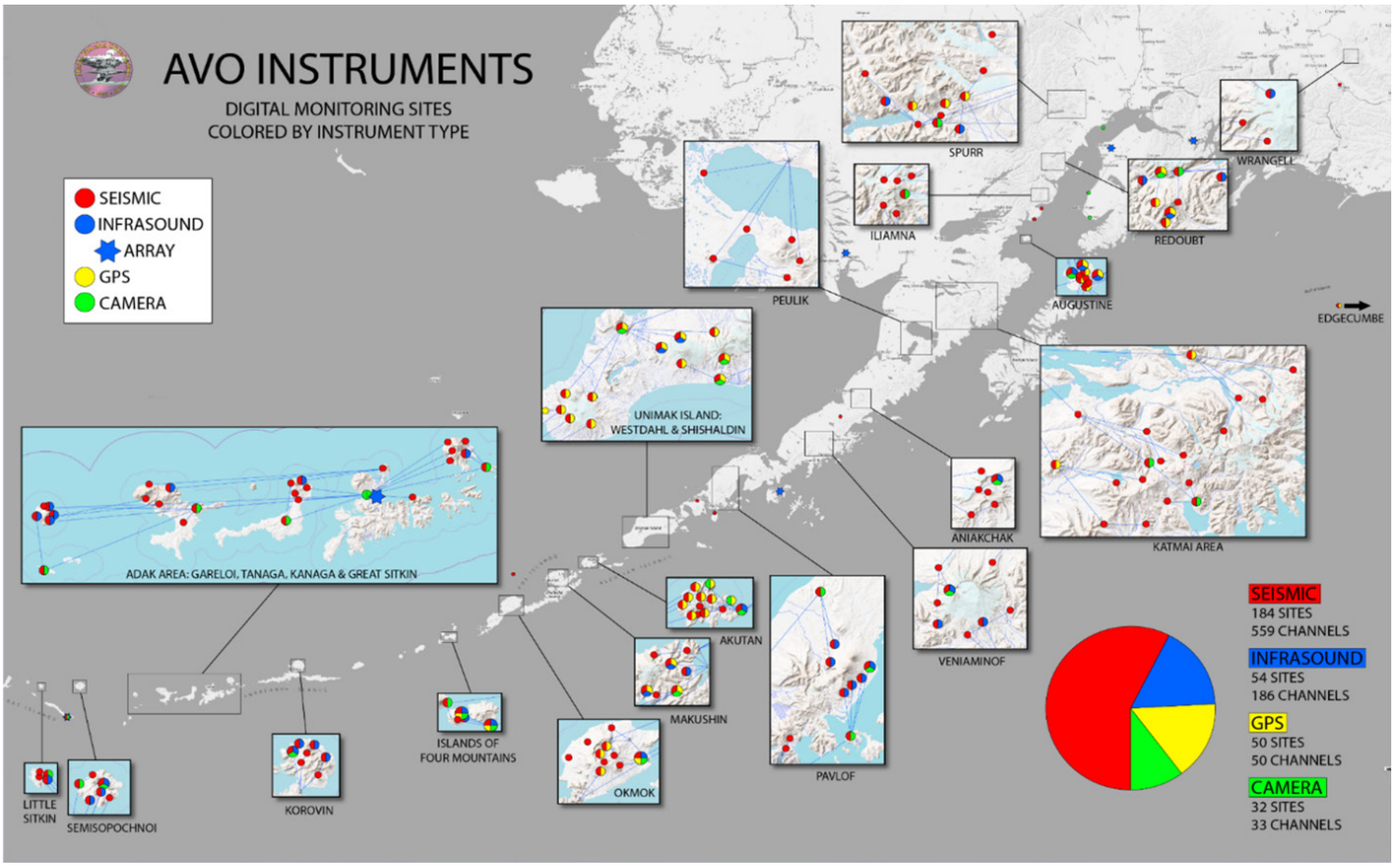
From left to right: Kate Bull, Lee Zirnheld, Scott Crass, Cheryl Cameron (Section Chief), Dain Harmon, and Abbey Nastan.

AVO 2023 OPERATIONS

2023 was AVO's first season following our intense, four-year "Analog to Digital" project (for more information about this project see previous Annual Reports). Consequently, 2023 was different from previous years as our work focused on maintaining our newly digital networks. During this field season, AVO field engineers and associates visited more than 76 stations across all but two of AVO's 30 monitoring networks; all of this was accomplished by 26 personnel over 534 person-days. To complete this work, DGGS contracted three helicopter vendors who flew a total of 124 days out of the 146 scheduled, for a total of 317 flight hours.

AVO operations included critical and routine maintenance, such as fixing solar panels broken by wind-thrown rocks, mending wires chewed by bears, removing expired batteries, and replacing faulty equipment. Major maintenance efforts were particularly applied to recently neglected networks at Akutan and in Cook Inlet, and joint operations between AVO and the Lamont-Doherty Earth Observatory at Columbia University were completed at Okmok

Scott Crass, Volcanology's IT Analyst, helping maintenance efforts on Kanaga volcano on a blustery day. Photo: Ellie Boyce (AVO-UAF).



Instrumentation on Alaska volcanoes at the end of the 2023 field season. Graphic by Dane Ketner.

and the Islands of Four Mountains volcanoes. In 2024, all stations installed by Columbia will be transferred to AVO.

Especially exciting for AVO this year was the completion of the first volcano monitoring network installed in Southeast Alaska at Mount Edgecumbe (see highlight). This network includes both seismic and Global Network Satellite Systems (GNSS) GPS stations. GNSS stations utilize international satellites to measure ground deformation (inflation or deflation), allowing scientists to detect magma movement under the volcano. New GNSS stations were also installed at Great Sitkin, Cleveland, Okmok, Tanaga, and Aniakchak volcanoes.

Repairs and upgrades were also done at several of AVO's receive facilities, where monitoring data converge and then pass on to AVO computers in Anchorage. Critical repairs and network "hardening" were done at the Amchitka Island receive facility in the far western Aleutians, where AVO engineers traveled by boat and hiked without helicopter support to complete their work. Receive facilities at King Cove and Dutch Harbor were also visited, and AVO's first successful Starlink was installed and made operational at King Cove.

In addition to our ground-based monitoring equipment and telemetry work, AVO geologists worked separately and in concert with field engineers to sample and map volcanic deposits on Great Sitkin, Shishaldin, Moffet, Adagdak, Makushin, Mount Edgecumbe, and Cleveland volcanoes.

2023 VOLCANIC ACTIVITY YEAR-IN-REVIEW:

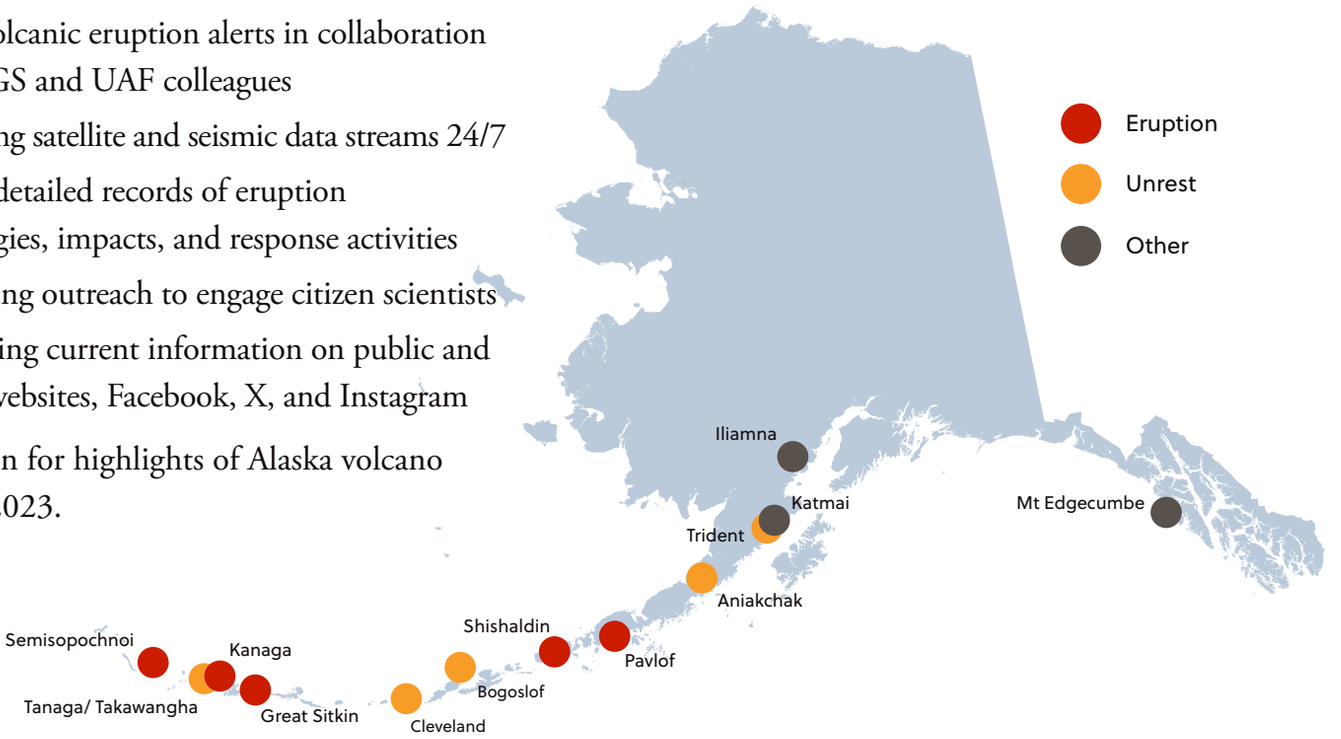
In 2023, Volcanology staff responded to volcanic eruptions at Shishaldin, Great Sitkin, Kanaga, and Semisopochnoi volcanoes, the tail end of the 2021–2023 eruption at Pavlof volcano, and significant unrest or other events at Edgecumbe, Iliamna, Trident, Aniakchak, Bogoslof, Cleveland, Tanaga, and Takawangha volcanoes, as well as many resuspended ash events in the Katmai area. Notably, this year was the first time AVO tracked seven volcanoes at elevated alert levels simultaneously!

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

Read on for highlights of Alaska volcano activity in 2023.

Helicopter and columnar-jointed lava on Great Sitkin Volcano. Photo: Abbey Nastan (DGGS).



See a photo you like?
There's more where that came from.
Explore a wide library of Alaska volcano photos at:
avo.alaska.edu/image/

Fieldwork at Pavlof to repair radio telemetry and check equipment. Photo: Ellie Boyce (AVO/UAF-GI)

Shishaldin 2023 Eruption

Shishaldin had a significant eruption in 2023, and there were 13 explosive events in total in 2023: five in July, three in August, three in September, and one each in October and November, with the most recent on November 3.

In 2023, ash was deposited on the communities of False Pass, Cold Bay, King Cove, and Sand Point at various times, and some flights were canceled or diverted. While AVO staff were performing maintenance work on the Unimak Island network in August, they were able to collect samples from the ongoing eruption.

Great Sitkin 2021–2023 Eruption

In 2023, Great Sitkin continued its slow and steady eruption of lava. This eruption began in 2021, and the alert levels for Great Sitkin remained at ORANGE/WATCH throughout 2023. AVO scientists visited the summit crater this year in September to collect lava samples from the current eruption and survey data to construct 3D models of the summit area.

Great Sitkin Volcano taken from a helicopter during AVO fieldwork, September 1, 2023. This view from the southwest shows the western and southern lava flows from the first phase of the current eruption on the flanks of the volcano, while the summit crater is more than half filled with lava, with steaming showing where lava is currently active. The intercrater glacier is visible behind the lava dome. Photo: M. Loewen (AVO/USGS).

The October 3, 2023, eruption of **Shishaldin Volcano** viewed from the northwest. The ash cloud extends to the southeast while steam emissions continue from the crater. Steam and dark deposits on the flanks are from hot pyroclastic flows and lahars that flowed down the sides of the volcano. Photo: Chris Barnes (Aleutian Airways).

Semisopochnoi 2018–2023 Eruption

Semisopochnoi, an island in the western Aleutians, hosts several volcanic features, including a 5-mile-wide caldera with several volcanic cones within it. Mount Young (renamed from Mount Cerberus this year) is the most active cone. The most recent eruption of Semisopochnoi began in 2018, and continued into 2023 with small explosions and low-level ash emissions until the alert level was returned to GREEN/NORMAL on August 3, 2023, as seismic levels returned to normal. Semisopochnoi continues to occasionally produce large steam plumes.

Still image captured by an AVO webcam on **Semisopochnoi** Island, showing degassing from Mount Young on January 19, 2023.

Kanaga Eruption

Kanaga Volcano, in the central Aleutians, experienced a phreatic (steam-driven) explosion on December 18, 2023. In response, AVO raised the alert levels to YELLOW/ADVISORY, where they remained for the rest of 2023 as seismicity at Kanaga remained elevated.

Bogoslof Unrest

In October of 2023, there was a major earthquake swarm at Bogoslof, which prompted AVO to raise the alert levels to YELLOW/ADVISORY on October 24. During the swarm, five to 10 events occurred per hour, and a total of ~1,100 earthquakes were recorded in one week. However, seismicity fell off after that, and the alert levels were lowered again to GREEN/NORMAL on November 24. No other signs of unrest were detected during this period.

Tanaga/Takawangha Unrest

Tanaga and Takawangha volcanoes make up two of the three volcanoes of the Tanaga volcanic complex, which occupies the northern half of Tanaga Island in the central Aleutians, On March 7, 2023, a major earthquake swarm began below Tanaga Volcano. As activity ramped up quickly to a rate of two to three events every minute and continued over the next three days, alert levels at Tanaga were raised to YELLOW/ADVISORY on March 7. During the next few days, earthquakes also occurred at Takawangha. On March 9, alert levels at both volcanoes were increased to ORANGE/WATCH, as the ongoing activity raised concerns of an imminent eruption from either volcano. However, earthquake activity started to drop off, and the alert levels for both volcanoes were reduced to GREEN/NORMAL on July 18.

Aerial view of **Iliamna Volcano** on July 25, 2023, from the southeast. The result of the June 5 avalanche on Red Glacier is clearly visible as the brown material on the snow. Photo: M. Herstand (AVO/USGS).

Mount Cleveland summit with Carlisle beyond, on May 31, 2023. Photo: Dane Ketner (USGS).

Iliamna Avalanche

On June 5, an increase in seismicity was noted on the volcano's seismic network, and AVO raised the alert levels to YELLOW/ADVISORY. That evening, a clear seismic signature of an avalanche was observed, and seismic activity fell off afterward. As a result, alert levels were lowered back to GREEN/NORMAL. Satellite views of the volcano from later in the month confirmed the large avalanche.

Trident Unrest

The current period of unrest began in August 2022 and has continued into this year. While Trident Volcano began 2023 at GREEN/NORMAL, an increase in rate and size of earthquakes spurred a rise in alert level to YELLOW/ADVISORY in February. In May, AVO began detecting an increase in low-frequency earthquakes between Trident and Novarupta. Low-frequency earthquakes often indicate magma or magmatic fluid movement within the Earth's crust. During the summer, ground uplift was observed at Trident in satellite radar data. As we close out 2023, earthquake activity at Trident continues at a slightly elevated rate, and it remains YELLOW/ADVISORY.

Aniakchak Unrest

During the recent episode of unrest, elevated seismicity was first detected in October 2022. However, in February 2023, the number of earthquakes beneath the volcano increased significantly and shifted to shallower depths. In response, AVO raised the alert level to YELLOW/ADVISORY. Additionally, satellite radar data showed high rates of ground uplift early in 2023, but the rate declined throughout March and April. As 2023 progressed, the rate of seismicity also declined, and AVO lowered alert levels to GREEN/NORMAL in August.

Cleveland Unrest

Mount Cleveland began 2023 at an elevated level but was lowered to UNASSIGNED (due to lack of a complete ground-based geophysical network at Cleveland) on January 5. However, seismicity increased in July, and AVO also detected elevated surface temperatures of the summit crater and continued gas emissions. AVO raised the alert level to YELLOW/ADVISORY, but seismicity then slowed in the following weeks, prompting a decrease to GREEN/NORMAL. **We are proud to write that, due to additional field work over the summer, in partnership with the AVERT (Anticipating Volcanic Eruptions in Real-Time) project at Columbia University, Mount Cleveland is now monitored with a five-station real-time seismic network. This network permits us to formally declare Mount Cleveland as GREEN/NORMAL.**

Highlight

Mount Edgecumbe Monitoring, Study, and Outreach

On April 11, 2022, AVO detected an earthquake swarm at Mount Edgecumbe in Southeast Alaska. Located on Kruzof Island, Mount Edgecumbe is about 16 miles northeast of the community of Sitka. At the time, Mount Edgecumbe had no ground-based monitoring network and had not erupted in several hundred years. The earthquake swarm subsided within a couple of days, but retrospective satellite data analysis showed ongoing inflation at Mount Edgecumbe, beginning in 2018. This inflation is best modeled as an intrusion of magma about six miles below the surface.

In May 2022, AVO installed a single seismometer and GPS station to assist with monitoring the new unrest, gave several presentations, and hosted question-and-answer sessions for Sitka residents. Later that summer, locals reported unusual bubbling on the flanks of Mount Edgecumbe.

Over the 2022–2023 winter, AVO planned an ambitious field season for 2023, which included installing three more seismometers to complete a seismic network and help more accurately locate earthquakes, adding three new GNSS sites to better measure the ongoing deformation, completing a robust gas survey (with attempts to detect, collect, and analyze gas from the bubbles), conducting geologic fieldwork, and continuing community engagement.

While school was still in session, AVO geologists Cheryl Cameron (DGGS) and Kristi Wallace (USGS) traveled to Sitka for an action-packed trip to discuss the community's now-active volcano. Activities included: two public presentations, an interpretive

Background. Early May 2023 view of Mount Edgecumbe (left) and Crater Ridge (right) from Sitka. Photo: Cheryl Cameron (DGGS/AVO).
Inset. AVO geophysicists Max Kaufman and Ronni Grapenthin install of a new GPS antenna monument on the eastern flank of Mount Edgecumbe, on August 21, 2023. Photo: Max Kaufman (UAFGI).

hike, a showing and discussion of the film *Fire of Love*, a program for young children, hands-on science sessions with high school students, a discussion about oral history and traditional ecological knowledge with Tlingit language learners, a radio show question-and-answer session, as well as meetings with the U.S. Forest Service, the U.S. Coast Guard, and the National Park Service.

The main period of helicopter-supported fieldwork occurred August 19–29, 2023, and involved personnel from all three AVO partner agencies: DGGS, USGS, and the University of Alaska Fairbanks Geophysical Institute. Beautiful weather helped us successfully achieve our goals, and Mount Edgecumbe now boasts a real-time seismic and GNSS network, enabling us to better detect and locate earthquakes as well as surface deformation. **This network is AVO's first and only network in Southeast Alaska.** Continuing geologic and gas analyses over the winter will help our understanding of Mount Edgecumbe's volcanic system and current activity.

Thank you to the U.S. Forest Service Tongass National Forest for permitting assistance and collaboration.

Above, left. AVO geologists Kristi Wallace and Cheryl Cameron talk to Sitka residents about Mount Edgecumbe, May 2023, at the University of Alaska Southeast Natural History lecture series. Photo: Cheryl Cameron (DGGS/AVO).
Above, right. UAF-GI graduate student Claire Puleio collects a gas sample in a copper tube for helium-isotope analysis from the "bubbling pond" on Kruzof Island on August 29, 2023. Photo: Laura Clor (USGS).
Left. AVO geologist Kristi Wallace (USGS) searching for young tephra deposits in muskeg bogs on the proximal flanks of Mount Edgecumbe on August 23, 2023. Photo: Cheryl Cameron (DGGS/AVO).

GEOLOGIC INFORMATION CENTER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Hugh Winston

The Geologic Information Center (GIC) provides publication, geographic information systems (GIS), and information technology (IT) support services within the division to provide timely, public access to geologic information. The GIC's ability to publish, host, and distribute large volumes of data allows DGGS to efficiently collaborate with federal and other state agencies. Our published services help 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.

This year the GIC facilitated the publication of 49 new geologic reports, maps, presentations, and datasets, including a new geologic map covering the pre-2008 eruption of Okmok Volcano. There are currently nine new geologic maps in production for publication next year as well as 16 geologic map conversions. We served over 38 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 4,500 followers on X, over 1,900 Facebook followers, and 530 subscribers to our news feed. DGGS staff also responded to hundreds of in-person, phone, and email information requests.

The Fraser Institute's 2022 Annual Survey of Mining Companies rated DGGS number two in the nation for the quality of our geological database, the quality and scale of maps, and the ease of access to data.

over **5,500**
publications released by DGGS since 1903

over **782,000**
items in the Geologic Materials Center inventory*
**An average Walmart Supercenter sells 160,000 unique items*

38+TB
digital data distributed in 2023

11,336 mi²
published geophysical survey data in 2023

49
2023 publications available at dggs.alaska.gov

336 mi²
published, peer-reviewed geologic mapping released in 2023

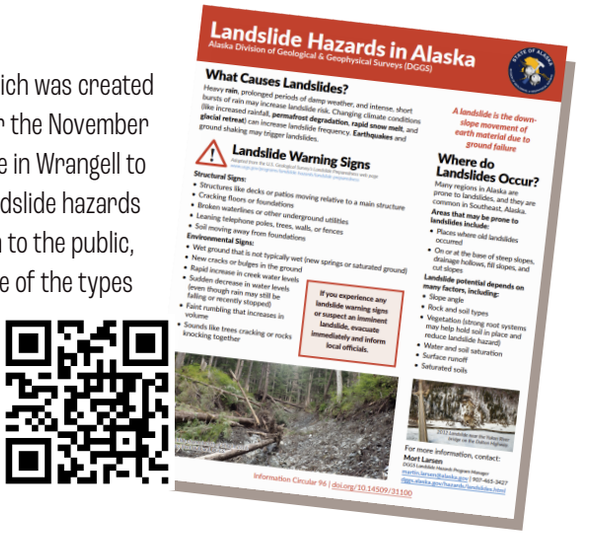
The GIC added three new positions in 2023 to support the continued growth of DGGS and the increased workload and range of required support tasks. As our GeMS Geologic Map production increases, so does the need for a dedicated quality assurance position. As a result, we hired a GIS Analyst 2, Ally Steinleitner, to support this critical requirement. We had also identified a gap in programming capability support within DGGS. To begin addressing this issue, we added two Analyst/Programmer 3 positions: Tommy Folan was hired to support the new multispectral scanner project and other tasks at the Geologic Materials Center in Anchorage, and Hugh Winston was hired to support our newly funded renewable energy program. The addition of these highly qualified and dedicated professionals has allowed us to better meet DGGS's publication, GIS, and IT requirements.

A LOOK INSIDE PUBLICATIONS

The GIC oversees the publication and distribution of DGGS's numerous maps, reports, and data releases. Publications include everything from handouts for the general public to technical reports, geologic maps, and complex data sets. At any given time, there are dozens of publications in the works, each with unique peer review, editing,

GIC staff created an online dashboard viewable in DGGS's geoportal to track publications through the multi-step review process, as well as present frequently requested publication statistics.

IC 96, which was created right after the November 2023 landslide in Wrangell to communicate landslide hazards and information to the public, is just one example of the types of publications GIC releases for the public.



and data management requirements. Numerous hours of review, layout, GIS work, editing, and metadata writing go into each publication, 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 simultaneously maintaining rigorous scientific standards. We utilize templates for frequently published data release types, scripts to easily compile metadata, and host teaching sessions on illustration and cartography so authors can confidently create their own figures and maps.

FIELD COMMUNICATION AND SAFETY

Fieldwork is the heart of DGGS's geoscience research. GIC personnel support our scientists with the training and equipment needed to operate safely in the field and respond to emergencies. Essential safety and communication equipment includes helicopter helmets, radios and repeaters, satellite phones, GPS trackers, and emergency first aid bivouac kits to equip roughly 50 staff and up to five distinct projects engaged in simultaneous fieldwork. In addition to providing equipment support for this year's fieldwork, GIC leads an annual collaborative review of the division's Field Operation Safety Manual and field safety outcomes.

DGGS GEOPORTALS – EASY ACCESS TO DATA AND APPS

GIC staff 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.

DGGS Geoportal

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, our geoportal's primary administrator, works hard to add numerous improvements and increase integration with the Alaska DNR ArcGIS Online Portal and the State of Alaska Hub site (gis.data.alaska.gov). We have over a thousand services and items on the DGGS Geoportal.

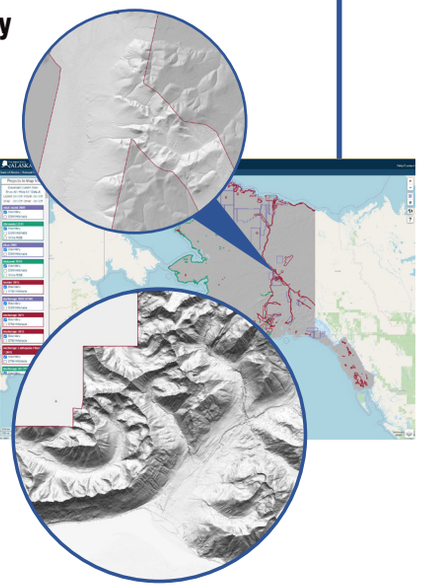
Our most popular services and apps

Exploration Geochemistry
42K+ views

Alaska Radon
21K+ views

Elevation Data Status
16K+ views

Geothermal Sites of Alaska Web Map
10K+ views



DGGS Field Geoportals

The GIC's IT and GIS staff worked to provide DGGS geologists with upgraded capabilities for long-term, multi-user field GIS data collection in areas without internet access. We developed a set of rugged, mobile field geoportals that run an installation of ArcGIS Enterprise on a lightweight mobile server that can be disconnected and transported to remote field camps. These field portals allow geologists to use mobile data collection apps like Esri's Collector or Field Maps and upload, share, review, and backup their daily work while operating in remote locations anywhere in Alaska. DGGS can also deploy these field portals for hazard response events and still collect, combine, and analyze data if internet connectivity is not available.

In 2023, the Field Portal was submitted to the University of Alaska Fairbanks's Arctic Innovation Competition. Oralee Nudson presented DGGS's submission, "Collaborative Field Data Collection Solution," which highlighted the development of the robust offline Field Portal and was awarded $2,100 in prize money. The design (see presentation) was based on our efforts to develop a field geoportal to support DGGS's geologic mapping requirements.

Alaska Elevation Portal

The GIC continues to work in partnership with the Alaska Geospatial Office to consolidate public domain elevation data for the state. Roughly 11 TB of point cloud, raster elevation models, and ortho-rectified imagery data is downloadable from our web app at elevation.alaska.gov. Additional data can be accessed from more than two hundred image services on our geoportal.

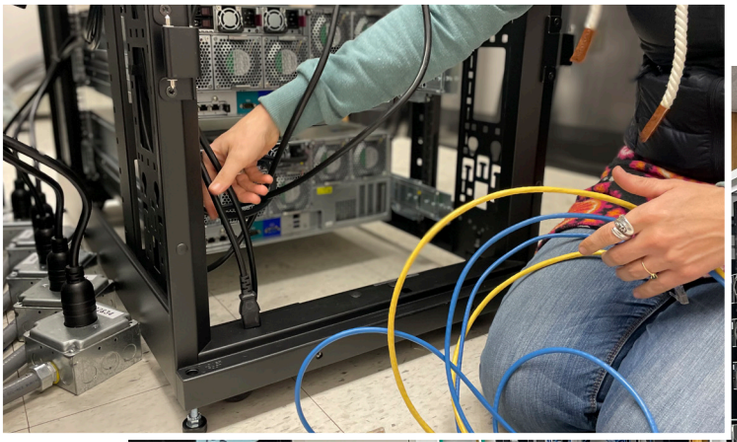
IT SUPPORT

The GIC's IT staff provides critical infrastructure and support to the division's geologists and scientists. Our highly skilled IT professionals provide effective, timely, and low-cost solutions to address a host of complex problems. They work closely and directly with domain experts, rapidly respond to issues, and develop cost-effective storage and processing solutions that support DGGS and many others throughout the state.

DGGS's website is an integral component in meeting our mission to provide timely and accurate data related to Alaska's natural resources and to support the systematic collection, evaluation, archiving, and distribution of geologic hazards data. The importance of this shared resource can be seen by the fact that our website distributed over 32 TB of data in 2023.

PROGRAMMING

The GIC's IT staff provides essential programming for a wide range of projects within DGGS while also maintaining multiple applications and databases, including the publications, photo, geochemical, and elevation databases, 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 Database, doi.org/10.14509/30900).



Select 2023 GIC Presentations

doi.org/10.14509/31020

Multimap geologic enterprise geodatabase efforts (presentation): United States Geological Survey Digital Mapping Techniques Workshop Series DMT2023, Anchorage, Alaska, May 20–24, 2023

doi.org/10.14509/31022

Developing, maintaining, and publishing documentation standards (presentation): United States Geological Survey Digital Mapping Techniques Workshop Series DMT2023, Anchorage, Alaska, May 20–24, 2023

doi.org/10.14509/31095

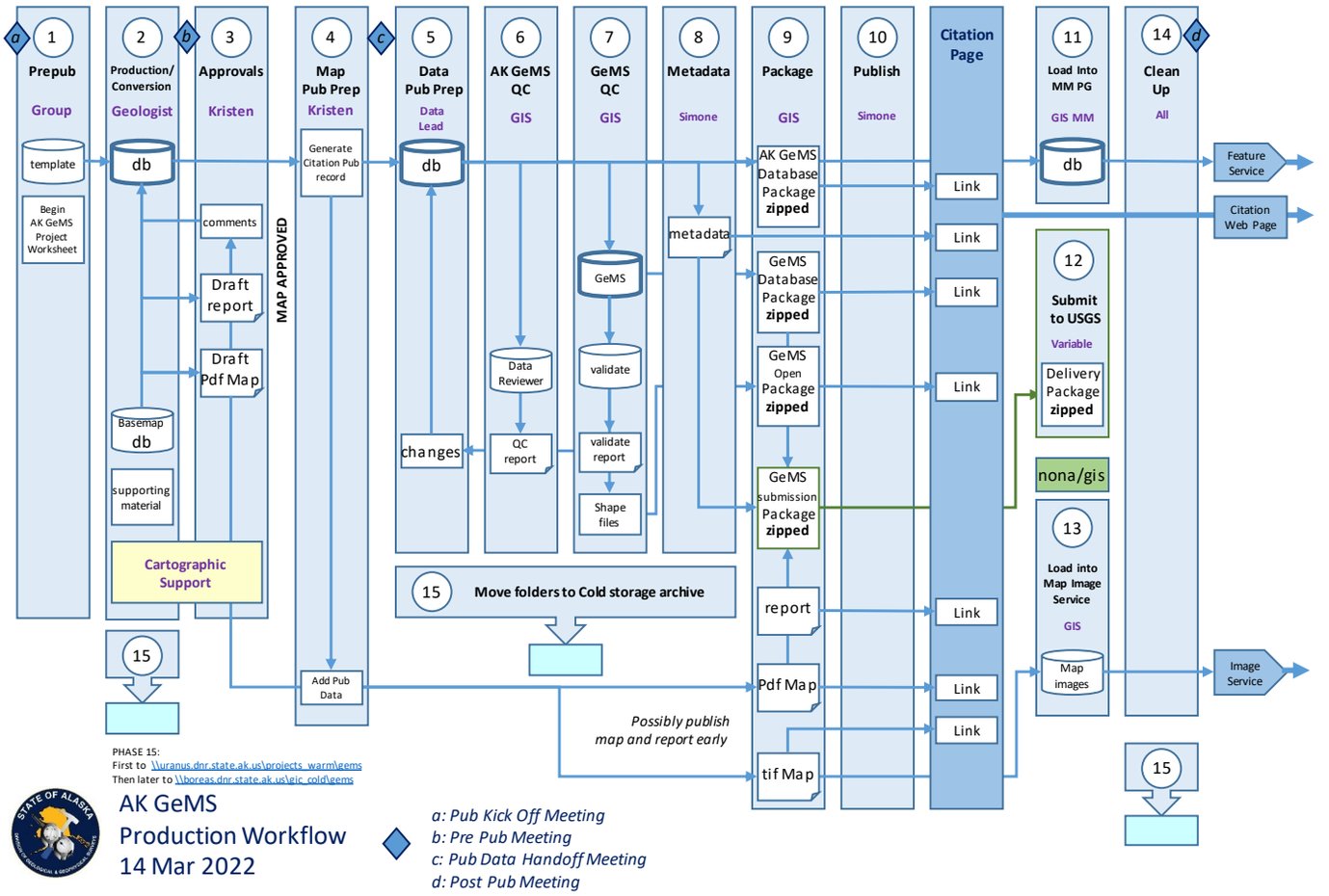
Designing a standards-based GIS production system in Alaska (presentation): Alaska Geospatial Summit, Anchorage, Alaska, Oct 25–27, 2023

Highlight

The Alaska Geologic Mapping System

GIC staff are a critical component in developing and maintaining DGGS's AK Geologic Mapping System, which produces standards-based, 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 (Geologic Mapping Schema—GeMS), and well-defined organizational procedures, including a 16-phase workflow to ensure high quality products are created and shared. Over 50 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 highly efficient mapping system is based on two primary published standards: *AK GeMS Symbology: A description of the AK GeMS Style File* (doi.org/10.14509/30584) and *AK GeMS Data Dictionary: A description of the AK GeMS database schema* (doi.org/10.14509/30669). 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



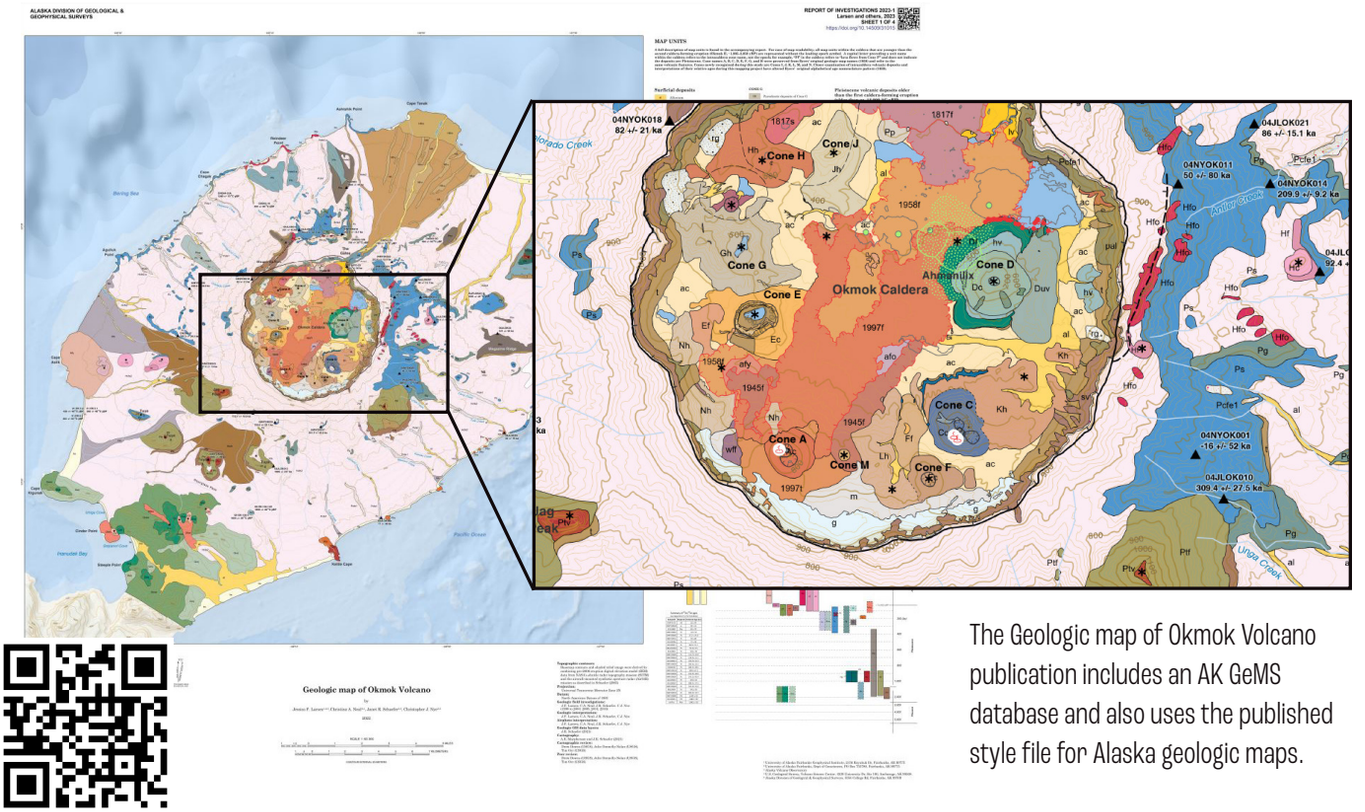
The GeMS workflow includes several steps to ensure each release distributes meaningful and accurate geologic data.

for multiple maps in a modern enterprise relational database. With our AK GeMS standard in place, we have increased our ability to efficiently create, store, and distribute meaningful geologic data for visualization and analysis. This past year our GeMS working group, the Geologic Data Inquiry (GEDI) council, developed and published version 2.0 of these standards.

Another critical component of this successful system is our comprehensive AK GeMS Production Workflow and Task List, which illustrates production phases and includes a detailed task and responsibilities list. Using this workflow, GIC staff efficiently perform data quality control checks, metadata creation, data packaging, and distribution of published data.

GIC staff also developed and implemented a comprehensive, semi-automated quality control process that has dramatically improved data quality. Building on this success, we hired Ally Steinleitner as our full-time quality control GIS analyst. She will work with the Esri Advantage Program to modernize our quality assurance/quality control (QA/QC) processes and data schema to leverage the full capabilities of ArcPro.

GIC staff, specifically Pedro Rivera, continue to work on our multi-map geodatabase and development of multi-map services and web apps. We continue to update scripts automating the ingestion of single-map AK GeMS databases into our multi-map database (MM DB) schema and have added more than 50 map databases into our multi-map PostgreSQL database. This year we continued to develop a robust AK GeMS MM DB Architecture that supports replications of data to increase speed and security. This upcoming year, we plan to work on symbolizing and creating web services of this data and develop a web app for public viewing.



The Geologic map of Okmok Volcano publication includes an AK GeMS database and also uses the published style file for Alaska geologic maps.

ALASKA GEOSPATIAL OFFICE

Leslie Jones

The Alaska Geospatial Office (AGO) works to advance the use of geospatial technologies as a tool to support decision-making in Alaska. We accomplish this through coordination of the Alaska Geospatial Council (AGC; agc.dnr.alaska.gov) and administration of the State Geoportal (gis.data.alaska.gov). Our goal is to ensure that current, reliable, high-quality geospatial data are available and easily accessible.

AGO's strategic goals are:

- Modernize Alaska's Spatial Data Infrastructure (SDI)
- Create a shared framework for geospatial policy and data
- Ensure geospatial data is FAIR—Findable, Accessible, Interoperable, and Reusable

Overall, the AGO strives to improve the quality and accessibility of geospatial data in Alaska through coordination across the state's geospatial community.

THE STATE GEOPORTAL

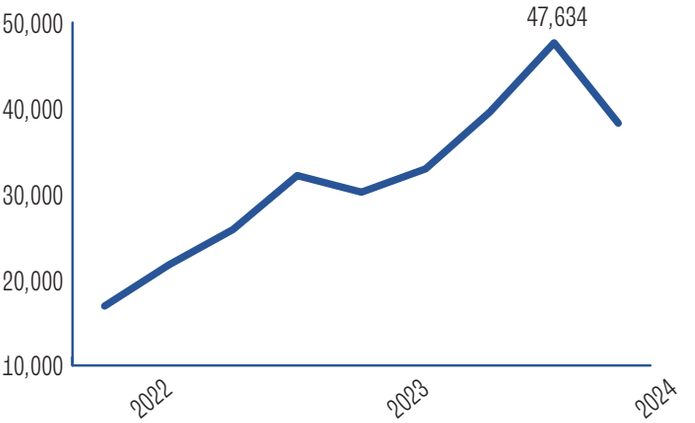
The State Geoportal, administered by the AGO, continues to provide access to location-based data, maps, and decision-support tools, which makes the state's vast collection of spatial data easier for the public to locate and use. The portal ensures decision-makers are accessing

real-time data from agencies and organizations across the state, reducing time spent sorting through websites and responding to data requests. The Alaska Geospatial Council (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 2023, the State Geoportal was visited by more than 65,000 unique users—a 350 percent increase from 2021.

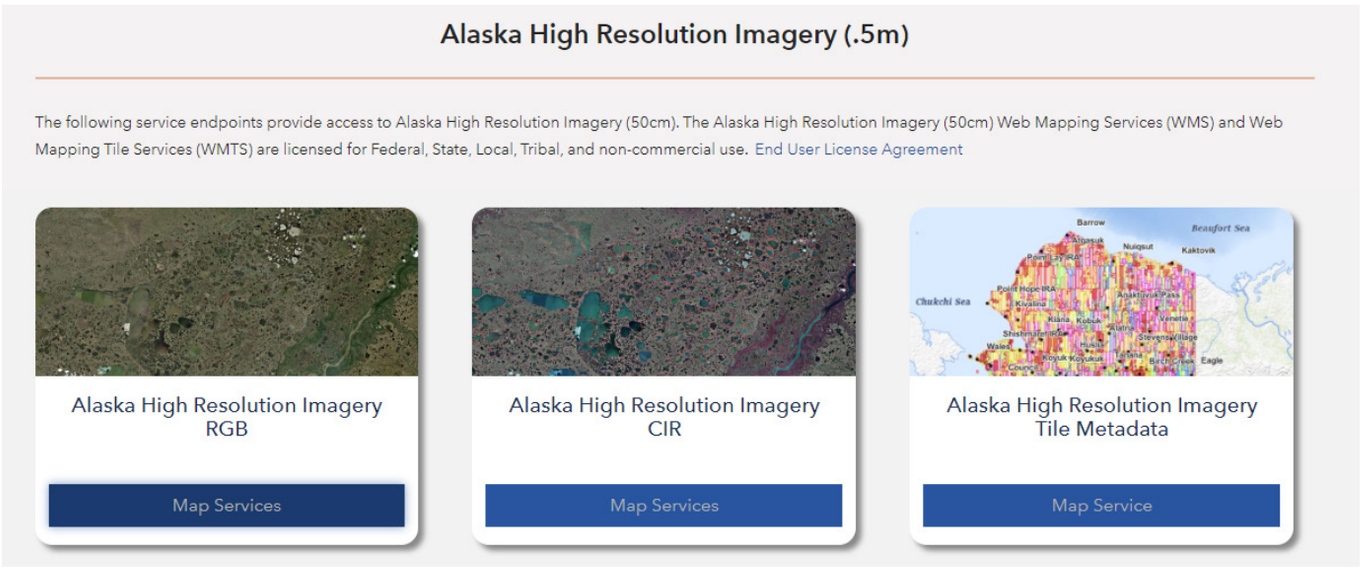
IMAGERY PROGRAM AND PORTAL

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. 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 340 million data requests from 160,000 unique users in 2023; data requests were up 90 percent from 2022.



Unique visitors to the AGO Imagery Portal through mid December 2024. Q3 in 2023 saw an all-time high of over 47,000 visitors.



ALASKA GEOSPATIAL COUNCIL

The AGC coordinates across stakeholder groups (federal, state, and local government, university, tribal, Native corporation, non-profit, and private) to fill critical gaps in geospatial data, reduce duplication of efforts, increase efficiencies in resource spending, break down data silos, and ensure long-term management of location-based data. In 2023, the AGC added a Food Security and Soils Mapping Working Group. The twelve working groups are supported by membership from across the nation and are: Imagery and Elevation, Hydrography, Wetlands, Cadastral, Vegetation, Soils, Food Security, Enterprise, Transportation, Geodetic, Coastal and Ocean, and Unmanned Aerial System (UAS) Policy.

Geologist Evan Twelker collects data on traverse during the 2023 field season.

The AGC continues to support the mission of the Alaska Mapping Executive Committee through regional and local coordination. This partnership resulted in a new statewide imagery mosaic for Alaska (30-cm resolution) and is supporting statewide mapping related to hydrography (surface waters), wetlands, shoreline and nearshore bathymetry, and lidar (elevation).

911 ADVISORY BOARD

Under Administrative Order 333, the geospatial information officer was appointed by the governor to the 911 Advisory Board; the board submitted their report to the governor's office in October. The report includes recommendations regarding vital statewide geospatial data needed to modernize 911 and help ensure the health and safety of Alaskans. Consistent statewide geospatial data, the integration of the data into Geographic Information Systems (GIS), and real-time delivery of data and maps to emergency call centers across the state are essential components of advancing 911 and providing improved services to underserved communities.

Alaska does not have the required statewide geospatial data needed to support 911:

- Physical addressing
- Parcel/land ownership
- Road centerlines for routing
- Emergency call center and provisioning boundaries

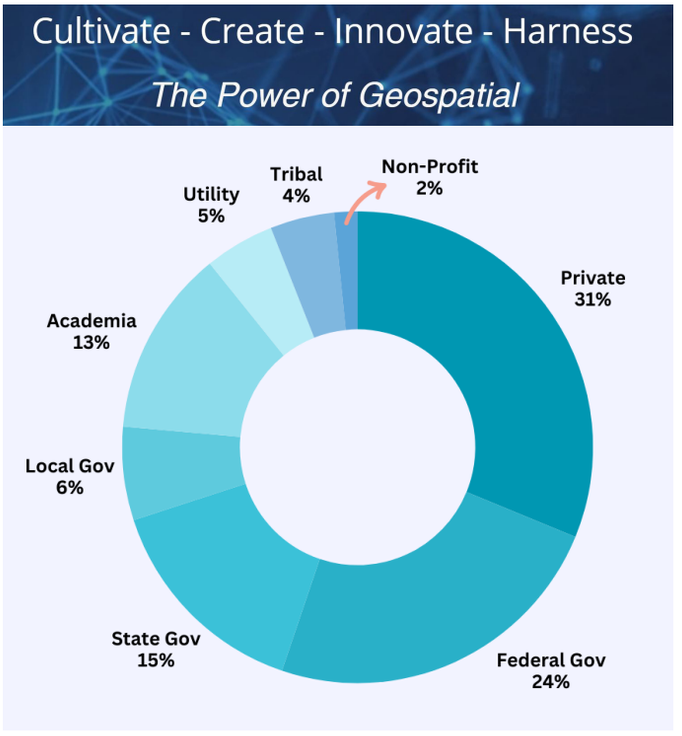
Key recommendations include how to fill data gaps and improve policy needed to support underserved communities in incorporated jurisdictions and unincorporated boroughs.

Highlight

2023 ALASKA GEOSUMMIT

In October, the AGO hosted the first Alaska GeoSummit at the Dena'ina Conference Center in Anchorage. The event was coordinated by the AGC and attracted over 325 geospatial professionals from the public, private, tribal, academia, non-profit, utility, and communications sectors. Presentations are published on the AGC website (agc.dnr.alaska.gov).

The event hosted 90 speakers over a three-day period, with presentations and panel discussions focused on data gaps impacting underserved communities. The story was the same across all sectors: there are more data gaps than funding, which highlighted the importance of collaboration, coordinated planning, and prioritization to ensure current funding is spent efficiently and effectively. Reducing the duplication of efforts across agencies and sectors will expedite access to decision-ready data and maps, specifically those needed to support statewide projects associated with the Bipartisan Infrastructure Law.



Conference participant percentages by affiliation type.

We asked the attendees to comment on key takeaways from the conference. The submissions summarized priority needs and opportunities ahead. Key conclusions from the geospatial community included:

- Increase local government and tribal participation in the Alaska Geospatial Council and geospatial community
- Policy, funding, and programs to support underserved communities, including the unincorporated boroughs
- Importance of workforce development in the state and remote communities
- Technical training and workshops to build and increase capacity in rural GIS programs
- Bridging literacy gaps through advocacy
- Capitalizing on public-private partnerships to leverage geospatial technologies

All regions within the state underscored the importance of geospatial data for promoting businesses in Alaska. No matter what business you are in, every decision starts and ends with a map.

ALASKA GEOLOGIC MATERIALS CENTER

The Alaska Geologic Materials Center (GMC), operated by DGGS, archives many decades' worth of geologic data consisting of energy, mineral, and geologic collections with an estimated replacement value exceeding $35 billion. The facility provides a wide range of users (industry, government, academia, and the public) access to samples for identifying new resource prospects and increasing our geologic knowledge of the state.

The new Anchorage repository opened on July 1, 2015, and has completed its eighth fiscal year, and fee collection began in fall 2018. There were 1,141 visits to the facility in CY2023, and while this is about three-fourths of pre-pandemic client traffic, it marks a 270 percent increase from CY2020.

The GMC's database-driven search engine allows users to view a real-time inventory of nearly 782,000 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 2023, 2.5 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 allows for the digital visualization and distribution of these datasets to the global geologic community. After several years of making strides towards acquiring non-destructive scanning equipment at the GMC (including Capital Improvement Project funds approved by

GMC staff from left to right: Gabriella Efird, Jean Riordan, Kaleb Smith, Alex Garcia, Kurt Johnson, Xianghui Zeng, and Andy Ethington.

2023...by the numbers

1,141 visitors

90,000 square foot repository

782,000 public sample items in inventory

the Governor and Legislature and two successful federal National Geological and Geophysical Data Preservation Program [NGGDPP] matching grants), a scanning platform was recently selected.

The HySpex scanning platform hosts a 3D surface profile laser, RGB camera, and four infrared cameras covering the shortwave to long-wave IR bandwidths. The contract was executed in December, and delivery of the scanning platform is slated for March 2025. Initial production scans of mineral and energy cores could start as soon as July 2025. The pending FY2025 NGGDPP Federal match grant seeks support for personnel costs, the scanning of priority core, and related programming.

Geologists from independent and major energy companies continue to visit the GMC 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 was made apparent during several industry workshops hosted at the GMC.

Above. DGGS geologists discussed current projects and presented core for the visitors to view.
Right. Members of the Alaska legislature and DNR staff visited the GMC to tour the facility and discuss DGGS research in November.

The second-most frequent visitors were from the mining industry, who often examined GMC core samples to identify a potential critical mineral nickel deposit in Southcentral Alaska. Boreholes from Duke Island and Kenai Chrome were also sampled to assess the potential for chemical capture of carbon dioxide.

In addition to industry visitors, academic researchers and geologists from other state and federal organizations visited the GMC.

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

- Santos (purchased Oil Search Alaska)
- Hilcorp Alaska
- ConocoPhillips Alaska
- 88 Energy
- Armstrong Energy
- Burgundy Exploration
- Geolog Americas
- Global Energy
- Rockwash Geodata Ltd. (Great Britain)
- Alaska Energy Metals (Millrock Resources)
- Kobold Metals
- Kougarok Mining
- Resolution Minerals
- Alaska Earth Sciences
- ASRC
- Bristol Bay Native Corporation
- Calista Corporation
- Alaska Volcano Observatory
- Various State of Alaska agencies
- USGS
- BLM
- BOEM
- EPA
- NOAA
- U.S. Department of Energy's Office of Fossil Energy and Carbon Management
- The universities of Alabama, Alaska, Binghamton, Minnesota, Stanford, Texas BEG, and Wisconsin
- The New Mexico Bureau of Geology

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 Division of Oil & Gas (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.
- DHSEM; in the Department of Military and Veterans Affairs, and the Department of Environmental Conservation to evaluate volcanic and other hazards, develop scenarios for hazards 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 Wrangell landslide events in November 2023. 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 Alaska Volcano Observatory, 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 partnership in the Alaska Volcano Observatory.

Federal Agencies

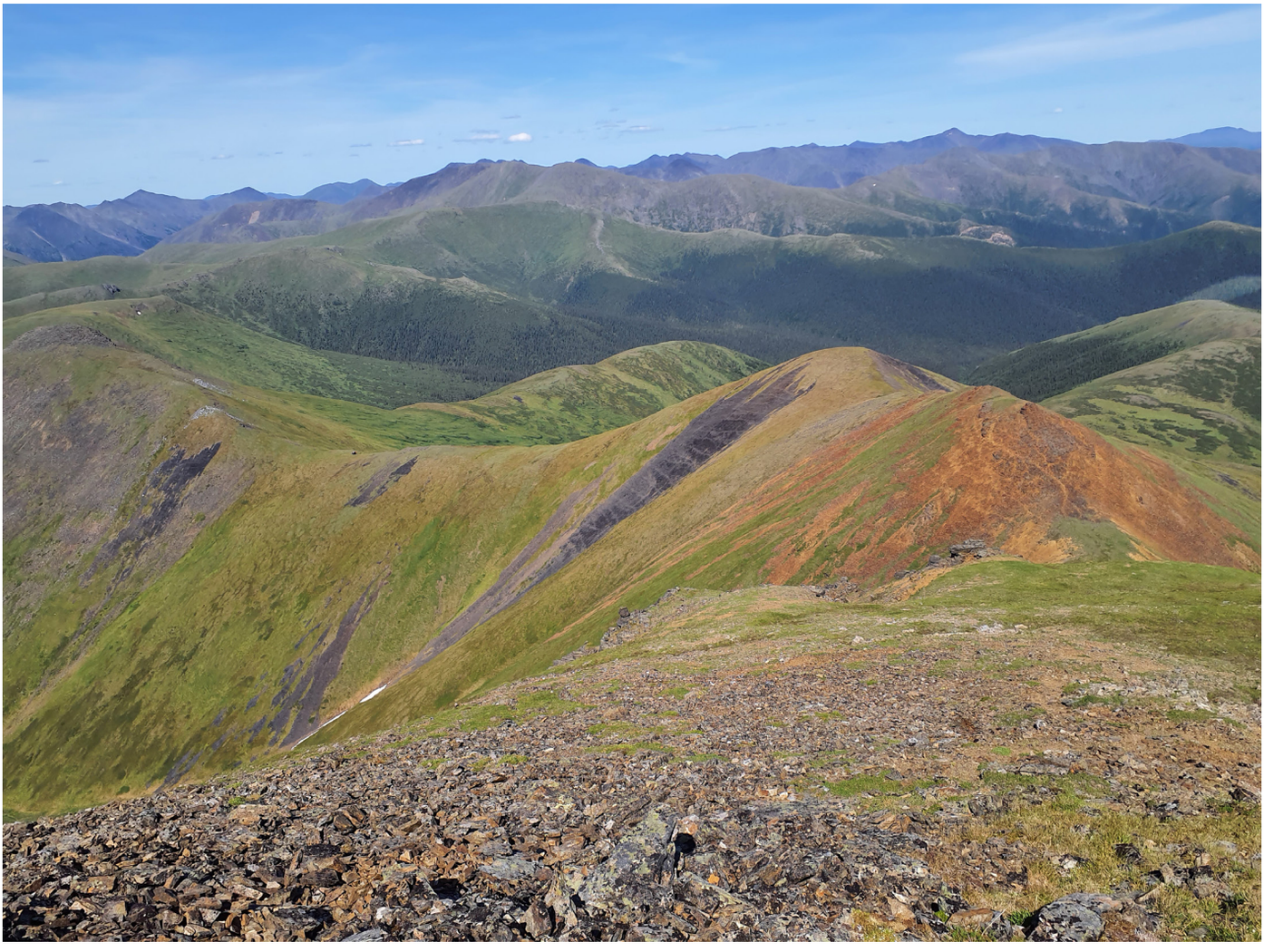
DGGS has cooperative programs with numerous federal agencies, including the USGS, NOAA, the U.S. Fish and Wildlife Service, NASA, the National Science Foundation, and periodically with FEMA, the U.S. Department of Housing and Urban Development, BLM, and the U.S. Department of Energy. In the past, DGGS has also engaged in cooperative programs with the U.S. Minerals Management Service, now 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 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 National Geological & Geophysical Data Preservation Program (NGGDPP) and the National Cooperative Geologic Mapping Program. The 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.



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

Geologist, Doyon Limited. Mr. Hanson is a Lands and Natural Resources Specialist representing Alaska Native corporations and communities and helping manage natural resource issues.

Dr. James Jones

U.S. Geological Survey, representing the federal government, mineral resources, and mapping interests. Jamey Jones is a geologist in the Anchorage office of the USGS Geologic Division, specializing in mineral resources and geologic mapping.

Dr. Tom Homza

Principal Regional Geologist, Shell Exploration and Production, Alaska. Dr. Homza has 20 years oil and gas exploration experience and represents petroleum industry interests.

Dr. Nicole Kinsman

Deputy Regional Director, NOAA/NWS Alaska. Dr. Kinsman has many years of experience helping mitigate coastal hazards in Alaska and understanding related storm and weather events.

Dr. Paul McCarthy

Chair of the University of Alaska Fairbanks, Department of Geoscience. 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.

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 related regulation.

Misha Ellanna

Geologist and GIS Analyst, Bristol Bay Native Corporation. Mr. Ellanna represents Alaska Native corporations and communities.

Kyle Brennan

Professional Engineer and Vice President, 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.

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

Eleven 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 Department of Natural Resources (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.

Welcome!

MELANIE WERDON–OUR NEW DIRECTOR & STATE GEOLOGIST

Melanie took over the reigns as director in December after joining DGGS as a geologist in 1999. For most of her career, Melanie's focus has been on minerals-related investigations and geology; primarily through her work with DGGS, but she gained valuable experience from her summer work with the mineral industry and the U.S. Geological Survey during graduate school. She received her PhD from the University of Alaska Fairbanks in 1999, where her work focused on Zn-Pb-Ag deposits in the northern Brooks Range. During her time as a geologist at DGGS, she served as the principal investigator for several multi-year-long mapping projects in Interior Alaska and on the Seward Peninsula and has been a vital part of the collaboration with the U.S. Geological Survey to evaluate Alaska's critical mineral potential and upgrade statewide exploration geochemistry datasets.

No stranger to a management role, Melanie has had two stints as the Mineral Resources section chief: from 2007 to 2012, and again from 2016 until she became the division's first female director in 2023. Despite her administrative responsibilities, Melanie still found time to participate in fieldwork as often as possible and authored scores of maps and reports. Her contribution to Alaska's geology and mineral resources knowledge over the past decades will continue to be an asset to the division as she focuses on fostering DGGS' state and national relationships.

Melanie's intense devotion to her work and the division, not to mention her geologic expertise, were already much-appreciated qualities during her time as section chief, and they make her an obvious and welcome choice as our next director. Welcome, Melanie!

SPECIAL THANKS TO KEN PAPP

Ken served as acting director for much of 2023, following Dave LePain's retirement. Ken, our division operations manager, stepped up to the plate to keep DGGS running smoothly, successfully juggled requests from the commissioner's and governor's offices, maintained building operations, and tackled day-to-day director tasks. Ken led the division while we mourned the loss of our division family in the tragic helicopter crash, helping coordinate response activities, and communicating with staff, the commissioner's office, and most importantly, the families of Ronnie, Justin, and Tori. Ken's empathy, patience, and dedication during his time as acting director is greatly appreciated by his DGGS colleagues. Thank you, Ken!

JOSH LONG

Josh joined the Energy Resources Section in April as a petroleum geologist. Josh earned his BS in geology from the University of Maryland, College Park, and an MS from Northern Arizona University. He then spent more than seven years with ConocoPhillips, with postings in Houston, Texas, and Anchorage, Alaska, where he was part of various teams focused on exploration, development, and technology. Josh returned to school and completed a PhD at Coastal Carolina University, where he gained valuable experience in Quaternary and modern depositional systems and published multiple papers in leading journals. His route back to Alaska included a prestigious Mendenhall Postdoctoral Fellowship with the USGS where he worked on outcrop and subsurface studies of the Tuluvak and Seabee formations on the North Slope. Josh is an accomplished clastic sedimentologist and has led numerous core workshops and field trips. He blends these skills with extensive experience interpreting subsurface well and seismic data. He is also an associate editor of the leading international *Journal of Coastal Research* and sits on the Community Advisory Board for the Department of Geological Sciences at the University of Alaska, Anchorage. When not chasing rocks, Josh enjoys spending time with his wife, two daughters, and two dogs in Anchorage.

SANDRA WALSER

Sandra Walser joined the Hydrology & Surficial Geology Section in March. She completed her BS in geology in upstate New York, followed by an MS in environmental geology at the University of Vermont. Sandra first realized she wanted to move to Alaska after completing her geology field camp with the University of Alaska in 2019. At DGGS, her main role is surficial mapping for the STATEMAP program, but also provides support to the Arctic Strategic Transportation and Resources project and the Landslide Hazards Program. Sandra enjoys GIS work as well as fieldwork, during which she can be found fervently digging soil pits. Outside of DGGS, she is usually skiing, climbing, fishing, or creating fiber art.

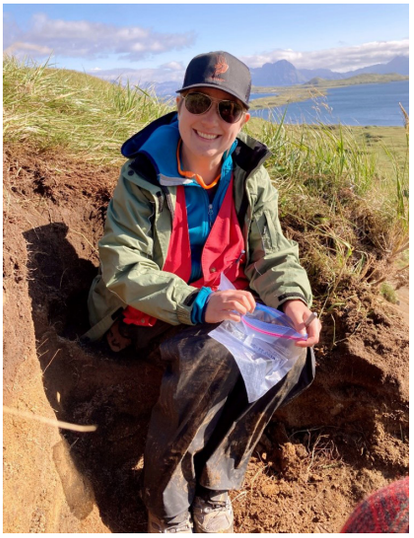
DAIN HARMON

Dain joined DGGS in March as the Volcanology Section's new Programmer/Analyst 3. Dain was born, raised, and educated in Fairbanks, Alaska. He has an MS in computer science from the University of Alaska Fairbanks (UAF); his thesis project focused on competitive AI. He has previously worked in video game development, as a Subaru car mechanic, and at UAF as a lab tech working on instrumentation for DNA detection and corrosion-cracking before joining DGGS. His hobbies include, unsurprisingly, video games, as well as "Maker" projects (the latest being building a Voron 0.2 3D printer).

LEE ZIRNHELD

Lee joined us in November as a geologist 2 in the Volcanology Section. Her primary job duties include handling all the field logistics for the Alaska Volcano Observatory and the Alaska Landslides Program. Lee hails originally from Massachusetts. She obtained her BA in theoretical and applied earth and environmental science (an interdisciplinary degree combining geology, meteorology, and soil science) at Cornell University. She eventually made her way to Seattle, where she joined the NOAA Ship *Rainier* as a hydrographic surveyor, working to update nautical charts along the shores of Southeast Alaska, Prince William Sound, Kodiak Island, and the Alaska Peninsula. She spent her vacations from the ship exploring and falling in love with the arctic, and eventually looked for work in Fairbanks. She spent about 12 years working as a research technician for a laser altimetry project in the Glaciology group at the University of Alaska Geophysical Institute, surveying glaciers in Alaska, the Yukon, and British Columbia. After a long hiatus, during which see obtained her nursing degree and worked as a wound and ostomy nurse, she is excited to join the Volcanology Section at DGGS. In her free time, she enjoys moving around in the outdoors on frozen and unfrozen ground and water, and thinning the forest and cutting snowshoe trails on the property she shares with her partner. Her other passion is playing music with friends, singing, and hacking around on various instruments.

ABBEY NASTAN



Abbey joined the DGGS Volcanology Section in 2023. She has lived in Colorado, Washington, Montana, Ireland, California, and Germany, and thinks Alaska is the most beautiful of all (bugs notwithstanding). Abbey earned her bachelor's degree in international field geosciences jointly from the University of Montana and University College Cork in Ireland. She then received a master's degree in planetary science from the California Institute of Technology. Afterward, she spent an interesting year teaching middle school science and moonlighting as a writer for *EARTH Magazine* before working at the NASA Jet Propulsion Laboratory. She spent seven years there working to maximize the societal benefit of NASA earth-observing satellite missions. Moving to Alaska in 2022 led to the opportunity to fulfill a lifelong dream of working for a volcano observatory, where she now spends her time wrangling databases, conducting fieldwork and mapping, and improving AVO's communications and outreach goals. Since coming to Alaska, Abbey has enjoyed adding foraging, fishing, and snowshoeing to her bevy of hobbies.

CONNER TRUSKOWSKI

Conner Truskowski joined DGGS's Geologic Hazards Section in May as a geologist 2. Originally from Anchorage, Alaska, Conner earned a BS in geology from the University of Alaska Fairbanks in 2020. During his time as a student, and after graduation, Conner spent five years working for various companies in the mineral exploration industry, soil sampling, core logging, and field mapping all over Alaska. When the opportunity to work at DGGS presented itself, it seemed like an excellent opportunity to broaden his experience. Aside from working with the Haines STATEMAP team as a mapper and data analyst, he enjoys spending time on his bikes and coaching youth cross country skiing.

PAUL GOODFELLOW

Paul Goodfellow joined DGGS's Geological Hazards Section in October as an environmental program specialist 4. Paul is the new manager of DGGS's Environmental Hazards Program, which includes the state Radon Program, naturally occurring asbestos contamination, the naturally occurring groundwater contamination program, and oversees the STATEMAP and NGGDPP grants. Paul completed his master's degree in public administration in May 2017 at George Mason University in the Washington, DC area; he also has a bachelors of arts in history and political science from the Evergreen State College in Olympia, Washington. Prior to arriving at DGGS, Paul worked for the Department of Environmental Conservation's Division of Air Quality for over five years as an air quality specialist. Paul is an avid traveler and enjoys spending time at home working on his vegetable garden with his wife and son.

NORA NIEMINSKI

Nora joined DGGS at the end of April 2023 to manage the Coastal Hazards Program in the Geologic Hazards Section. Nora grew up in Utah, where she stayed to (ski and) earn her BS in geology and a BA in French from the University of Utah in 2011. Nora also has a PhD in geological and environmental sciences from Stanford University and has expertise in sedimentary geology, stratigraphy, source-to-sink sediment transport, coastal and marine depositional systems, and linking the stratigraphic record to geologic hazards. She has done extensive fieldwork and research in Namibia, New Zealand, California, southern Utah, and offshore central California to Cascadia. Before coming to Anchorage, Nora worked with the Monterey Bay Aquarium Research Institute and then as a research geologist at the U.S. Geological Survey Pacific Coastal & Marine Science Center in Santa Cruz, California.

JESSIE CHRISTIAN

Jessie joined the DGGS's Geologic Hazard Program in the Coastal Hazards Program in June 2023. She earned her BS in marine science from Coastal Carolina University in 2020. She then went on to complete her MS in geoscience–geography at the University of Alaska Fairbanks in 2023. She has traveled to over 20 rural, coastal communities conducting coastal hazards research and continues to work with Alaska Native communities to monitor their shorelines. Welcome, Jessie!

WES BUCHANAN

Wes joined DGGS's Mineral Resources team in January 2023 as a GIS specialist and field mapping geologist. Wes has a BS in geology from the University of Kentucky, an MS degree in geology from Auburn University, and a professional masters in mineral exploration from the Colorado School of Mines. His academic research focused on the tectonic evolution of the New England Appalachians and the Caledonides of eastern Greenland and northern Norway. His techniques combined field mapping, structural analysis, petrology, geochemistry, geochronology, and phase equilibria modeling to elucidate the timing and conditions of orogenesis. Wes comes to us (most recently) from the Kentucky Geological Survey, where he was a field geologist working on surficial quadrangle mapping. He brings a uniquely diverse background in geology, including conducting academic research, teaching university courses, managing a geological summer field camp in Colorado and Utah, working as a petroleum geologist and consultant, and managing emergency medical services. In his current position with DGGS, Wes assists with the conversion of legacy geologic map data into ArcGIS databases using the Geologic Map Schema (GeMS) standard and helps conduct field work and analysis on rocks from the Yukon-Tanana Upland with the Earth MRI project.

Wes grew up in Franklin, Tennessee, where he lived in the same house, and went to the same school with the same people. By the time he turned 18, wanderlust had firmly set in. Over the next 15 years, he moved to Kentucky, Alabama, Montana, Nebraska, Wyoming, Colorado, back to Kentucky, and then finally found Alaska. Most of these adventures have been with his wife and travel companion, along with a clowder of feline friends. As a youth, Wes was in Boy Scouts, where he found a love of hiking, backpacking, and map orienteering, which has parlayed nicely into a life as a field geologist. Wes looks forward to many more field seasons and working to unravel the geologic history of Alaska with DGGS.

LOGAN FUSSO

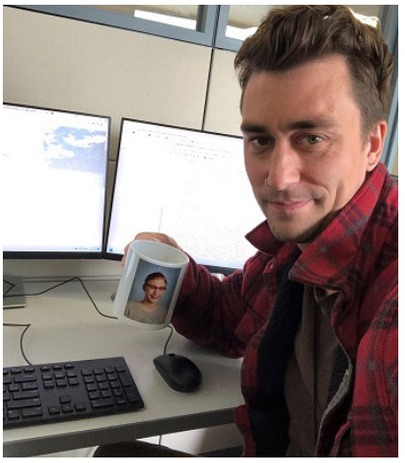
Logan joined DGGS's Mineral Resources team as a geophysicist in December 2023. Originally from Washington, Logan earned his BS in geology from Western Washington University in 2011. After a few years as a field technician for the Washington State Department of Natural Resources Statemap and Geothermal Research teams, as well as a stint as a lidar technician with Quantum Spatial, he rejoined the world of academia at the University of Alaska Fairbanks in 2019, working toward an MS in geophysics, specializing in geodesy. His thesis project focused on InSAR remote sensing of volcanoes and volcanic processes. His research in remote sensing deformation techniques was noticed by the Hawaiian Volcano Observatory (HVO), and he was offered a position as their deformation technician as he finished his MS in geophysics at UAF. Besides deploying GNSS sensors and post-processing data for the annual campaign, Logan spent ~two years working with HVO deploying field instruments and upgrading geophysical instruments for volcanic monitoring systems. He's happy to return to Fairbanks to work in the Mineral Resources Section.

When Logan is not at work, he enjoys backcountry adventures with his wife and friends. You might find him climbing, floating rivers, or even surfing, depending on the season.

ALLY STEINLEITNER

Ally joined DGGS at the end of September as a GIS analyst II in the GIC. Originally from California, she completed her bachelor's degree in 2022 in geography/environmental studies, with a focus in GIS at the University of California, Los Angeles. Looking to move somewhere with more mountains and moose, she headed to Southcentral Alaska, where she designed GIS databases and performed field work for invasive species management programs for the National Park Service and the U.S. Fish and Wildlife Service. In her role at DGGS, she conducts quality control of the division's digital and map-based geological, geophysical, and geochemical data and converts AK GeMS databases to federal schema for grant deliverables, publications, and distribution. When she's not focusing on tables of data, she enjoys hiking, cooking, skiing, printmaking, and sea kayaking. Welcome, Ally!

HUGH "HUEY" WINSTON



Huey joined DGGS as an analyst/programmer for the GIC based in Anchorage. Huey has a BS in mathematics and an MS in statistics with a concentration on classification algorithms. Prior to joining DGGS, Huey worked as a statistical tech for the Alaska Oil and Gas Conservation Commission and a research analyst at the Department of Health. In addition to his role at DGGS, he is also an adjunct professor at the University of Alaska. While not working or teaching, Huey can be found playing an assortment of instruments (including drums, guitar, piano, saxophone, and handpan) or working on home-improvement projects with his wife.

THOMAS FOLAN

Thomas first joined DGGS as an intern, and we are happy that he has now transitioned to a full-time position as an analyst/programmer III for the GIC in Anchorage. He has six years of programming experience and application development and has worked with relational databases, standard programming tools (compilers, debuggers, revision control), as well as experience with Golang, Java, and SQL on PostgreSQL. He has a MS in interdisciplinary studies from University of Alaska, Anchorage, where he developed a predictive snow depth model for the Northern Hemisphere.

THE DGGS QUILT CLUB

DGGS has a unique, long-standing tradition of making quilts to commemorate life events for fellow staff members. Participants in this informal group collaborate to decide on a pattern, theme, and fabric choices with each recipient in mind and often meet after work to plan and sew together.

This year the quilting group was extra busy making multiple retirement, wedding, and new baby quilts, and, most notably, remembrance quilts for the families of Ronnie, Justin, and Tori. These quilts are truly a group effort and exemplify the community-minded spirit at DGGS.

Farewell!

DAVID (DAVE) LEPAIN

Dave retired (for real this time) in 2023 after serving as the division's director since March, 2022. Dave began working at DGGS in 1998, before leaving to work at the Wisconsin Geological and Natural History Survey in 2003. He returned to Fairbanks, and DGGS, in 2006 before leaving *again* in 2012, unable to pass up an opportunity to work for Saudi Aramco in Dhahran, Saudi Arabia. Lucky for us, he returned to DGGS two years later to serve as the division's petroleum geologist and Energy Resources Section Chief. Dave was looking forward to a quiet retirement when former director Steve Masterman retired in 2023. Always with the division's best interests at heart, Dave graciously postponed his retirement to take on the role of director.

A quick study, Dave soon mastered the role of leading DGGS and representing the division at the state and federal levels. His careful, humble, and judicious approach to leading the division was greatly appreciated by staff and coworkers. Despite his new role rubbing elbows with lawmakers and policymakers, Dave always found time to "talk shop" about geology around the office, reminding staff that sedimentary rocks are perfect and far superior to their "messy," metamorphosed brethren.

A highly experienced geologist, Dave's work in Alaska focused on the North Slope, including the northeastern Brooks Range, Cook Inlet, and several Interior sedimentary basins. He was an accomplished author in his time with the division; his name is attached to over 80 DGGS publications, not to mention his contributions to external publications.

Now that Dave is retired (again, for real!), he is finally pursuing a life-long goal of purchasing a sailboat and embarking on new maritime adventures with his wife, Joan. Dave's expertise and sense of humor will be greatly missed, and we wish him well on his new adventures in retirement!

DE ANNE STEVENS

De Anne retired after almost 33 years with the State of Alaska (all at DGGS). She started work with the state as an intern and worked her way up through the ranks as a permanent, full-time geologist. She became chief of the Engineering Geology Section at DGGS in 2007, which, under her thoughtful guidance and development, eventually became so large and industrious that it had to be split into two new sections: the Geologic Hazards and Hydrology & Surficial Geology sections. She continued in the role of section chief for the Geologic Hazards Section until she retired in June 2023.

Her main research focus was surficial-geologic mapping, Quaternary studies, permafrost and periglacial processes, geologic hazards, construction and placer materials resources, and the use of satellite remote sensing for geologic applications. Although her many management and administration duties kept her mostly office-bound in the latter part of her career, she was an experienced field geologist. She conducted numerous surficial-geologic field mapping and engineering-geology studies throughout Alaska, from the Brooks Range to the Kenai Peninsula, and from the Canada border to the Alaska and Seward peninsulas. Since she began working at DGGS in 1990, she has authored or co-authored an impressive 354 publications!

For many years De Anne took on a lead role in organizing first-aid, bear, and firearm training courses for DGGS field staff. When Paula Davis, long-time DGGS editor, retired in 2017, De Anne became the go-to for the definitive answer to tricky grammar and usage questions (she was also bequeathed the appropriate title of "DGGS Mom"; the title was similarly retired at the end of her state service). Her seemingly endless knowledge of DGGS's history was invaluable to the division. She could give context to projects, reports, and personnel changes at the drop of a hat. Similarly, De Anne was also the go-to person for answering questions about state policies or procedures.

One of her most-appreciated ad hoc roles at DGGS was keeper of the Snack Cart. Her often-invisible effort to keep DGGS staff fed and hydrated for many years is just one example of the extra lengths De Anne would go to both professionally and personally for the division. She was also—and continues to be—a regular contributor to and coordinator of the DGGS Quilt Club, an informal group that sews quilts to commemorate life events in fellow staff members' lives.

Thank you, De Anne, for your many years of service to DGGS! Your expertise, knowledge, and contributions to the DGGS family will be missed!

ALICJA WYPYCH

Alicja joined the Mineral Resources mapping team as a geologist 3 in 2013. Her first field project was in the Talkeetna Mountains, and after a few fine traverses down brushy creeks in the rain, Alicja knew she had found her new professional home. She went on to apply her knowledge of geochemistry and igneous petrology to projects throughout Interior and Southcentral Alaska. Her geochemical knowledge played a substantial role in streamlining the publishing and interpretation of such data. Alicja pushed the Mineral Resources Section into the current field data collection system—a seamless, state of the art system allowing the group to quickly interpret a multitude of data collected in the field and post-field analyses, advancing the geologic map production process. She also led the team as Principal Investigator for the Northeast Tanacross (2018) and Western Tanacross (2020) geologic mapping projects. In addition to her scientific skills, Alicja was a team member who could be counted on to tackle difficult technical problems, whether that be the setup of field computers or creating custom calibrations for our X-ray fluorescence instrument. With her guidance, the hand-held XRF became a critical instrument in recognizing the plethora of rocks in Interior Alaska. While Alicja's hair color has changed over the years, her devotion to her family and her "puppers" has remained constant. In October 2023 she moved back to Poland for family reasons—we wish her the best in her next chapter as she rejoins her family in Poland!

ALEC WILDLAND

Alec Wildland joined DGGS as a student intern geologist with the Mineral Resources Section in the spring of 2019 to aid new mapping in the Yukon-Tanana Upland as part of the Earth MRI team. Alec completed his MS at the University of Alaska Fairbanks in 2022 while focusing on metamorphic petrology, structure, and monazite geochronology. His expertise in structural geology and geochronology made him a valuable member of the Earth MRI team; he continued as part of the team for the next four years as they traversed from east to west across the Yukon-Tanana Upland.

Alec also worked on the team developing a multi-map, multi-user database model based on the single-map Geologic Map Schema (GeMS). He successfully created several geologic map databases from historical DGGS maps. Alec left DGGS in the summer of 2023 after he accepted a geologist position at Jacobs Engineering in Fairbanks. We wish him luck in his new position!

AUTUMN POISSON

Autumn joined the DGGS Coastal Hazards Program in June 2022, when she first moved to Alaska. During her time with DGGS, Autumn assisted with field planning, project tracking, and flood assessment methodology evaluation. Only months after joining DGGS, Autumn helped with the division's response to Typhoon Merbok. She also assisted the Coastal Hazards Program during its transition in management and coordination of collaboration with the Alaska Ocean Observing System program. Autumn plans to move back to the Lower 48 and we wish her the best in her next venture.

ZACK SIEMSEN

Zack joined the DGGS Coastal Hazards Program in late 2021. In his time with DGGS, he helped coordinate critical field data collection efforts and conducted image analysis for coastal investigation projects in remote Alaska communities. Zack also helped with the installation, monitoring, and maintenance of several water-level sensors throughout Alaska. Zack is still in Alaska, and we wish him well in his future endeavors!

Alaska Division of Geological & Geophysical Surveys

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