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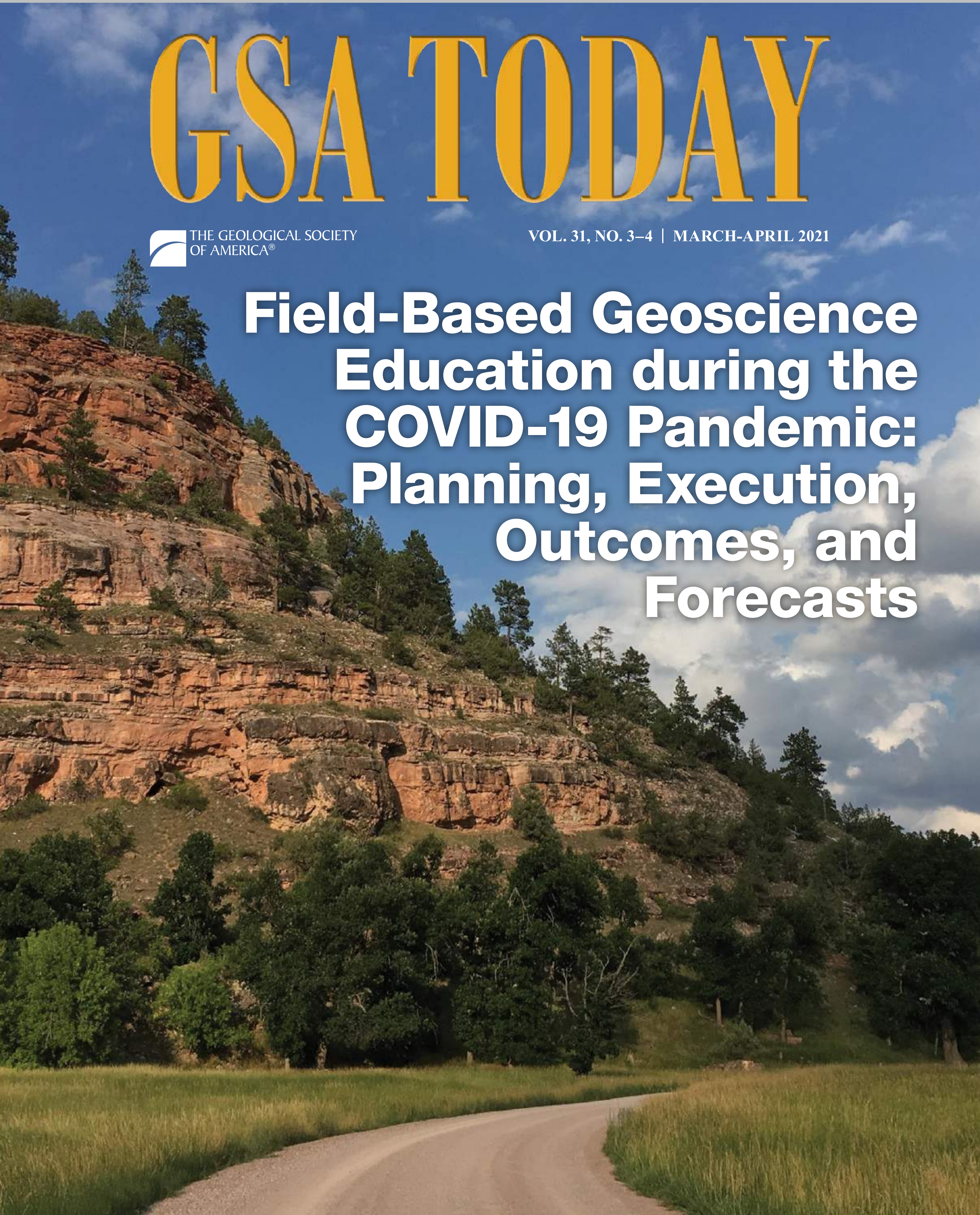
GSA TODAY

THE GEOLOGICAL SOCIETY OF AMERICA®

VOL. 31, NO. 3–4 | MARCH-APRIL 2021

Field-Based Geoscience Education during the COVID-19 Pandemic: Planning, Execution, Outcomes, and Forecasts



MARCH-APRIL 2021 | VOLUME 31, NUMBER 3–4

GSA TODAY

GSA TODAY (ISSN 1052-5173 USPS 0456-530) prints news and information for more than 22,000 GSA member readers and subscribing libraries, with 11 monthly issues (March-April is a combined issue). *GSA TODAY* is published by The Geological Society of America® Inc. (GSA) with offices at 3300 Penrose Place, Boulder, Colorado, USA, and a mailing address of P.O. Box 9140, Boulder, CO 80301-9140, USA. GSA provides this and other forums for the presentation of diverse opinions and positions by scientists worldwide, regardless of race, citizenship, gender, sexual orientation, religion, or political viewpoint. Opinions presented in this publication do not reflect official positions of the Society.

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SCIENCE

Cover: The Pennsylvanian–Permian Minnelusa Formation (Minnelusa means “rapid water” in the Sioux language) crops out in an area known to Rocky Mountain geologists as “The Amphitheater” near Beulah, Wyoming, USA, and is one of the classic mapping areas for the Black Hills Natural Sciences Field Station. Situated between the Williston, DJ, and Powder River basins, this >200-m-thick succession of interbedded sandstone, mudstone, limestone, dolostone, and evaporite deposits is a key petroleum reservoir for the Rockies and is interpreted to represent an ancient sabkha environment, similar to the modern sedimentary environments of coastal Abu Dhabi. Image courtesy of H.F. Filkorn. See related article, p. 4–10.

GSA NEWS

THE GEOLOGICAL SOCIETY OF AMERICA®

Field-Based Geoscience Education during the COVID-19 Pandemic: Planning, Execution, Outcomes, and Forecasts

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ABSTRACT

The undergraduate geoscience experience typically culminates in a field-based capstone course that utilizes outcrop mapping, geologic observation, and interpretation across multiple disciplines to provide the graduating geologist with fundamental field-mapping skills. However, due to the COVID-19 pandemic, many of the field-based geoscience programs have been temporarily suspended or shifted to an online format. To address the demand for graduating seniors in the broad field of geoscience, the South Dakota School of Mines and Technology developed an innovative hybrid course consisting of two parts: (i) a 14-day online course on geological field methods, followed by (ii) a 15-day in-person geologic mapping course based out of Rapid City, South Dakota, USA. Analysis of this new hybrid course provides a benchmark on how to develop and execute field-based geoscience education with greater accessibility to field geology through a combination of online and face-to-face teaching. Our hybrid course model was taught during the first summer of the pandemic (28 June to 28 July 2020), and this experience provided the following insights: (i) there are four key stages to leading a field camp over a five-month timeline: development, logistics planning, implementation, and review; (ii) key decision makers and stakeholders in the process include the students, instructors, field-camp logisticians, campus dining and housing facilitators, field-station director, department chair, provost, and the Board of Regents; (iii) logistics, transportation, accommodation, and dining services require advanced levels of consideration to adequately address COVID-19–related risk and uncertainty; (iv) online teaching and exercises can address geological field methods, but they cannot adequately assess a student's ability to map geology in the field; (v) field-mapping exercises need to be adjusted to reduce the number of people in one field area and lower their interaction to support social-distancing guidelines from relevant government and health authorities; and (vi) plans need to be put into place for overall health and safety as well as contingency plans in the event of an outbreak before and during the field camp. We hope that this experience of delivering a geology field camp during the COVID-19 pandemic is useful in providing a benchmark on reasonable field-camp practices, identifying critical successes and unknowns, and guiding field-camp development during pandemics. We also hope this contribution will serve as a useful guide for universities and businesses that intend to engage in face-to-face activities during this time of uncertainty.

INTRODUCTION

Undergraduate geoscience disciplines set themselves apart from other natural science curricula in that they generally require a multi-week field-based geologic mapping capstone course to graduate. These field camps cover a broad spectrum of topics, including the subfields of sedimentology, stratigraphy, mineralogy, structural geology, and metamorphic and igneous petrology. Some specialized field camps provide more opportunities for students to develop their interests in fields such as volcanology, geophysics (Bank and Rotzien, 2007), structure and thrust-belt tectonics, sedimentary basin analysis and applied petroleum geoscience (Anderson et al., 1999; Rotzien et al., 2020, and references therein), or environmental hazard mitigation. Whichever type of field camp a student chooses to complete, it is intended to be one of the highlights of their undergraduate geoscience learning experience. However, during the COVID-19 pandemic, many field camps were canceled, postponed, or fully converted to an online format. These cancellations and modifications caused demand for face-to-face field camps for graduating seniors to rise. In order to address this demand, the Black Hills Natural Sciences Field Station (BHNSFS) at the South Dakota School of Mines and Technology (SDSMT) developed a hybrid course consisting of two parts: an online geological field methods course followed by a field-based geologic mapping course.

The task of building this hybrid course was not a simple process. Constructing a field camp during the COVID-19 pandemic required attention to key factors, including: (i) pre-camp online field methods exercises; (ii) logistics, such as accommodations, dining, and transportation; and (iii) contingency

GSA Today, v. 31, https://doi.org/10.1130/GSATG483A.1.

plans in the case of an outbreak before or during the camp. Building this field camp required significant planning, execution, success—and serendipity—in key areas.

While this course was developed in response to the COVID-19 pandemic, its application is not limited to public-health concerns that limit face-to-face instruction. The geoscience field by its nature requires an intimate understanding of the natural world and, as such, often relies on field-based observation and research. Furthermore, most job descriptions for geoscientists in the U.S. as well as abroad specify the need for fieldwork and competency in working in the field (sensu Oliveri and Bohacs, 2005). Unfortunately, the requirements of a field-based capstone undergraduate course can inadvertently restrict access to our science. A multi-week field-based geologic mapping course can be problematic for non-traditional students with family and work obligations that prevent them from traveling to a remote field site for an extended time. Furthermore, the cost of some field-based mapping courses is prohibitive for low-income students, thereby potentially limiting the diversification of practitioners within the geosciences (see Chiarella and Vurro, 2020, for an in-depth discussion on this topic). This public-health crisis also presents an opportunity: by developing robust remote learning opportunities to cultivate geologic mapping skills, we provide an accessible and alternative pathway to experience the capstone undergraduate geoscience course.

While this paper describes just one experience, and we do not have access to every available data point at this time (reviews are still being generated for this course), we feel we do have a particularly insightful view of several key concepts for developing and delivering a hybrid course during the COVID-19 pandemic. This paper has three primary aims: (i) to characterize the portions and extent of the planning, execution, and review process for this course; (ii) to issue a qualitative analysis of what worked and what did not work for this course, from the various perspectives of key stakeholders, including students and instructors; and (iii) to provide a method for an ideal set-up for a hybrid online and field course during a pandemic anywhere in the world.

COURSE DEVELOPMENT AND PREPARATION

Here we present the four key stages in delivering a hybrid course. The following stages took place over a six-month time period from March to August 2020 and include course development, logistics planning, implementation, and review. The planning for the online and field-course phases is outlined in Table 1 and divided broadly into early and late-stage deliverables and considerations.

Preparation for the online course started shortly after most U.S. institutions shut down or were locked down due to the outbreak in mid-March 2020. At this time, universities and colleges canceled face-to-face instruction, closed most of their facilities, and sent students home to finish out the school year through online instruction. As the pandemic situation progressed and affected summer travel plans, multiple field courses that the BHNSFS operates internationally were soon canceled; U.S.-based courses were postponed and then finally arranged for an online format. However, there still existed a need to deliver a field course for students wishing to complete their field component and finish their undergraduate education requirements during the summer. In April, our team of instructors began planning for the hybrid online and field-course logistics and curriculum.

Because a five-week–long standard field camp was not feasible for health and safety reasons, we decided on a hybrid course with two distinct parts: (i) a 14-day online webinar-based portion followed immediately by (ii) a 15-day face-to-face field-based portion held in Rapid City, South Dakota, USA. This course was approved because it satisfied the requirements set forth by relevant university and government guidance: (i) having a best practices plan in place for travel, accommodations, dining, and fieldwork; (ii) providing a method for departure and travel to field areas; (iii) incorporating best health, safety, and environmental (HS&E) practices while in the field; and (iv) having a contingency plan in case someone showed symptoms or tested positive for the virus.

Our online geological field methods course is divided into four primary modules: (i) an introduction to field mapping and reading geologic and topographic maps (three days); (ii) sedimentation, stratigraphy, and basin analysis (four days); (iii) structural geology, and fracture analysis, and mapping geologic structures (six days); and (iv) a final project encompassing mapping, sedimentation, geomorphology, and structural analysis (one day). A new skill or topic pertaining to mapping and interpreting surface and subsurface geological areas of interest was introduced each day.

Our 14-day online portion had 45 students from 18 different U.S.-based undergraduate institutions, and our field-based face-to-face portion had 30 students from 14 different institutions. The course was intentionally designed such that students were given assignments that would take anywhere from 6 to 12 hours to complete. In addition to hand-drawn maps, topographic profiles, and cross sections, only our virtual platform (Zoom), Google Earth, R. Allmendinger's Stereonet, and standard word processing software (Microsoft Office) were required to complete the exercises.

IMPLEMENTATION AND RESULTS

A Typical Online Course Day

A typical online day consisted of four main parts: (i) an introductory informal discussion about the course or exercise from the previous day; (ii) a lecture covering a new topic of interest; (iii) a description of the new project or exercise of the day to be completed by the students for a grade; and (iv) an afternoon Q&A session typically in a group forum lasting 1–2 hours to cover any existing questions the students had regarding the exercise.

We covered topics of the day, including pacing, three-point problems, planar measurements (strike and dip of bedding, joints, etc.), trend and plunge measurements, interpreting physical stratigraphy, measuring stratigraphic section, building weathering profiles to trace mappable units and formation boundaries, interpreting depositional environments, measuring fractures and folds, strike/dip and trend/plunge measurements, mapping geological contacts and structures using both field photos and remote sensing data, using geomorphology and outcrop weathering patterns to trace lithofacies and formation boundaries to establish structures, and more. Following the lecture and a short break, the instructor would then present the daily exercise. Overall, most morning lectures and exercise introductions took ~2–3 hours to complete.

Following the end of the morning session, each recorded lecture was submitted to the course platform—D2L—an online repository for all materials. Each PowerPoint lecture and slides were also submitted to D2L by the end of each day, along with the project description and grading rubric. It was critical to be able to grade everything using digital copies to return to the students who were

TABLE 1. SUGGESTED CHECKLIST AND TIMETABLE FOR A SUCCESSFUL HYBRID ONLINE FIELD METHODS AND FIELD COURSE

	Students	Instructors	Course leadership (director)	Logistics
6 months until course	Evaluate camps to attend in USA and internationally, and apply	Define objectives and scope of class for online and field portions; seek rules and regulations from government authorities (travel bans, virus testing requirements)	Advertise field camp; identify pre-planning issues and challenges pertaining to scholastic, ADA, and logistical needs	Discuss with course leadership what is required for the camp
5 months until course	Register for field camp based on available opportunities	Brainstorm projects and generate risk matrix for evaluating projects	Work with all stakeholders and state government to develop health and safety plan; oversee development of projects that serve the needs of the student	Iterate scenarios and camp requirements with course leadership; finalize what is required to run a safe field camp
4 months until course	Take any remaining prerequisites	Develop projects in line with objectives; identify list of necessary equipment for online and field courses	Compile and finalize equipment and requirements list from all stakeholders (i.e., what do they need to be successful?)	Reserve vehicles, accommodations, dining programs, based on information from course leadership
3 months until course	Complete pre-camp readings; continue to complete course prerequisites	Test projects and peer-review among the instructors; reevaluate the scope, goals, and deliverables for each project	Guide project development; work with all stakeholders to complete tasks	Prepare site for field camp; run-through of contingency scenarios identified by leadership and instructors and other governmental and health authorities
2 months until course	Students acquire necessary equipment for course	Test online delivery; scope out field areas for feasibility due to changing environmental and health and safety issues	Assess final peer-review of projects	Work with instructors and leadership to finalize a contingency scenarios document
1 month until course	Pack and final preparations for course	Finalize project preparation	Final coordination with all key stakeholders	Final coordination of all logistical items including travel, vans, dining, accommodations
Online course delivery (Phase I)	Attend course, learn, complete exercises as part of a team, receive and implement feedback on exercises	Deliver course lectures, Q&A sessions (for credit), exercises; grade exercises; provide feedback to students and other instructors regarding academic and logistical challenges	Provide evaluations of course content to instructors; continue to work with accommodations, vehicles, dining to prepare for field-camp phase	Final check and amendments due to changing needs and last-minute alterations, if needed
Field camp delivery (Phase II)	Attend course, learn, complete exercises, receive and implement feedback on exercises	Using health & safety guidelines developed for this course, deliver course lectures, Q&A sessions, exercises; grade exercises; provide feedback to students and other instructors regarding academic and logistical challenges	Observe and evaluate the range and variability in project outcomes to compare merits, limitations, and provide feedback to instructors and key stakeholders	Deliver on all items; maintain open communication with instructors to see what works and what doesn't
Post-course review	Implement new knowledge on geoscience toward graduate school or career; provide written and oral feedback on the course to all stakeholders	Meet to discuss merits, limitations, pitfalls and suggestions and critiques for next learning event	Meet with all stakeholders to discuss merits, limitations, pitfalls, and suggestions and critiques for next learning event	Meet with stakeholders to discuss merits, limitations, pitfalls, and suggestions and critiques for next learning event

working in all parts of the country. This online field-methods course required modules from five instructors and the director of the BHNSFS, totaling ~80–200 hours of work per instructor to prepare, deliver, and complete grading for the online course exercise. By the end of the 14-day online phase, the students had received 15 GB of data, information, and exercises, constituting thousands of hours of analysis and a huge scientific, technical, and economic value.

Pre-Trip Planning and COVID-19 Infection Scenarios

In the weeks leading up to the field-based portion of the course, instructors and the director alike consistently reminded the students to use social distancing and quarantine measures and other health and safety guidelines to limit the risk of becoming infected with COVID-19 prior to arrival in Rapid City. Students were encouraged to drive to Rapid City, if possible. Students and instructors who flew to Rapid City Regional Airport were encouraged to wear a face mask in transit to and from the airport, during the flight, and while in the airport. Since there were no widely available testing kits at the time, no tests were administered prior to the field course.

The pre-planning and execution of the logistics and safety included general daily practices for students and instructional staff: (i) students and staff should have a pocket-sized card with the Center for Disease Control (CDC) list of COVID-19 symptoms for reference; (ii) students should be encouraged to practice respiratory etiquette by covering coughs and sneezes and wash their hands or apply hand sanitizer afterward; (iii) members of the camp would maintain social distancing of 6 feet (2 m) while on campus and in the field areas whenever practical and during meals in the cafeteria or outside; and (iv) separate cohorts should not be around one another or interact at any time throughout the duration of the course. The final part was quite difficult during meal times and likely during afterhours.

If at any time a member of the course were to test positive, it was important to have contingency plans. Should one person in the cohort test positive, then the entire cohort would have to go into quarantine and either finish the current field project or begin online instruction modules for the 14-day period as per South Dakota Dept. of Health Guidelines. Should an instructor become infected and thus unable to effectively teach, then the other instructor of the cohort would have to oversee the cohort and implement the online instruction until the infected instructor could begin working again. There should be at least two additional instructors to fill in as replacements should the need arise.

A Typical Field-Course Day

Many of the field-course days were similar to camps in pre–COVID-19 times, yet due to the shortened and condensed nature of the 15-day field course and increased safety precautions, the schedule and projects necessarily had to change in specific ways. The field phase of the course featured three mapping projects, each in a different location, which allowed students to map and interpret structural domes, igneous intrusive bodies, and metamorphic basement rock assemblages to gain confidence in understanding complex structures and also appreciate the diverse and challenging geologic history of the Black Hills.

Mapping projects were introduced via Zoom the evening prior to the field mapping day. Every field area that was typically mapped in previous years was downsized to a small section of area to map because the number of field days for each project was decreased by ~20%–50% in order to complete three projects in less than 15 days. Project descriptions, assignments, related materials, and base maps were assembled by the instructors into large envelopes, and one was delivered to the door of each student's dormitory room to limit face-to-face contact. Students were divided into three cohorts, each containing 10 students, and two faculty were assigned to each cohort. On mapping days, students had breakfast from 6:30–7:30 a.m. Each of the field vehicles, vans, was loaded with five students and one instructor, who also served as the driver, and departed for the field at 8 a.m. Typical drive times to the field areas were roughly 40–80 minutes, allowing mapping from ~9 a.m.–4:30 p.m. Students worked in groups of two at each field area and were required to wear face masks when less than 6 feet (2 m) apart (Fig. 1). At 4:30 p.m., vans departed the field area and returned home for dinner at 6 p.m. Nightly virtual lectures occurred at 7:30 p.m. Logistics pertaining to the specific details of transportation, accommodations, and dining are described in the following sections. All students brought their own laptops except one, and that student was provided a laptop by the university.

When selecting project areas, consideration was given to the additional need for extra parking space given that the field camp was operating with twice as many vans as usual and there had to be enough room to not only accommodate the extra vans, but if two or more cohorts were at the same project area, then there had to be enough room for each cohort to be properly distanced.

Another key difference was that in a traditional field-camp course, there is likely a senior instructor or camp coordinator who would act as the lead instructor to facilitate the outcrop lectures and discussions and/or other faculty who would take turns as lead instructor for different projects based on their areas of expertise. There may even be cases where in the traditional setting, several instructors may come and go over the period of six weeks to lead the various projects. Under the cohort model that we employed, each cohort had two instructors assigned to the 10 students for the entire time, and there were no exchanges or visits by other instructors. The instructors for each cohort had to be comfortable and familiar enough with the geology of each of the project areas to be able to lead the outcrop discussions and not rely on the senior instructor or another instructor for each of the different projects.

Transportation

Each cohort of 10 students and two faculty was assigned two 12-passenger vans for transportation to the field, to evenly divide the cohort (Fig. 2). Front-to-back passenger seating in the four rows of each vehicle was 2 – 1 – 1 – 2, and passengers were required to wear face coverings at all times in the vehicle. Prior to entering the vehicle, temperature checks were recorded. Students were required to sit in the same

Figure 1. Students and instructors maintain social distancing and wear masks while mapping geologic structures in the Black Hills of South Dakota (July 2020).

Figure 2. (A) Each cohort of ten students and two instructors was divided into two vans for transport to and from field areas; (B) temperature checks were recorded prior to loading the vans; and (C) upon arrival in the field, vans were unloaded from front to back and then sanitized as part of a multi-point COVID-19 safety program.

seat each day, and vans were loaded from back to front and unloaded from front to back. Upon reaching the field and home destinations, disinfectant spray was used on all handled interior and exterior vehicle surfaces. Furthermore, windows were kept open and air conditioning could be set to high, but not to max because that would recirculate air.

Accommodations

Field-camp leaders worked closely with SDSMT campus authorities to accommodate students in single-occupancy dorm rooms to mitigate the risk of a potential outbreak. Each 10-student cohort was placed on a separate floor in Connolly Hall residential dormitory. Three instructors and 10 students lived off campus, so only four instructors and 20 students lived on campus for the duration of the field camp. On campus, all members of the field camp were required to socially distance and wear face coverings. While it was impractical to monitor students' after-hours activities, students were encouraged not to go off campus because of the risk of being introduced to COVID-19 at bars and other areas where social gatherings are common.

Dining

Field-camp leaders worked closely with SDSMT campus authorities to provide safe meals to mitigate the risk of a potential outbreak. Dining took place at Surbeck Center in the main cafeteria. Upon entry and wearing a face mask, members of the field camp were to stay spaced 6-feet (2 m) apart while a member of the dining team served them their meal. Blue-tape Xs were placed on the floor to remind students to keep the space of social distancing. Self-service was minimal. The dining room tables were spaced far apart and only one person was allowed per table to facilitate social distancing. Furthermore, laminated cards with "clean" and "dirty" sides were used to show which tables had been cleaned and were ready to accommodate a diner, and following a meal, the card was to be flipped over, revealing to the dining team that the table needed to be cleaned prior to accommodating the next diner.

INTERPRETATION AND REVIEW OF THE HYBRID COURSE

Students, instructors, and key stakeholders of the South Dakota state university system provided important feedback (both anonymous and not) on the merits, limitations, and attributes of this course. First, the introduction to field mapping methods online served three important purposes: (i) to provide distinct exercises, most of them in different sedimentary basins from around the world and each on a different mapping topic that is critical to the development of a well-rounded and successful field geologist; (ii) to introduce digital mapping methods, including the use of freely accessible high-resolution imagery and 3-D visualization such as Google Earth to aid in the field mapping process; and (iii) to teach observational skills and first principles in sedimentary basin analysis (i.e., what are the lithofacies, and how are different sedimentary structures throughout turbidite beds used to determine paleocurrent direction, or what are the types of fractures, faults, and folds used to indicate a certain type of deformation?). Probably the most popular feedback from students was the enjoyment of using Google Earth to provide big-picture interpretations of structure. Second, students were challenged to learn about a new basin or a completely new concept each day. This can take some focus and is akin to the block program featured at some universities in the U.S., including Colorado College. Finally, students enjoyed the fact that each day was a new topic, so that they remained rather fresh and engaged throughout the course.

Some of the key limitations included: (i) exercises were demanding and took significant time, with some students turning in homework after the midnight deadline; (ii) the material was completely new and took focus to learn new lexicons of geologic terms required to adequately perform the exercises; and (iii) Internet connectivity issues may have prevented students from hearing the entire lecture live. We addressed these limitations by lowering the workload and setting greater flexibility on deadlines; cutting back on the introduction of new and technical terminology; and recording lectures and putting them and lecture material online the same day.

The 15-day field phase featured modules on rock identification, Laramide orogeny–related intrusions, and the metamorphic core of the Black Hills. The key observations of this portion of the course included (i) the regular four-day field mapping projects were challenging to scale down to two- to three-day–long mapping projects with the additional health and safety requirements that were needed and in the absence of a day off each week as in the past (five days were previously allowed to grade each project); (ii) more time and lead time is required to do nearly everything in the field camp due to HS&E requirements, leading to longer days for all involved; and (iii) it is more challenging to deliver feedback in the form of grades and constructive criticism when there are no days purely devoted to rest for the students and grading for the instructors.

While four days in the past were adequate to map structures such as the peak near Elkhorn Resort, an asymmetric dome with an underlying intrusion just east of the Wyoming–South Dakota border, the limited time and necessary spacing of cohorts required careful logistical planning. Additionally, flexibility was paramount. Limited time meant that the students might be able to identify rock types and get the structure correct, but for projects in the metamorphic core of the Black Hills, it became exceedingly difficult to recognize multiple Black Hills deformational events in just two days of mapping. Second, the enhanced HS&E protocols required longer times to do nearly everything because they were accomplished by cohort, from breakfast, to loading the vans, to turning in homework, to distributing field equipment, including Brunton compasses and GPS units. However, one camp event that likely was made logistically easier during this course was the evening virtual meeting to introduce a new project or to review Black Hills geology. Third, the feedback on student projects necessarily needed to be accelerated because there were no rest days in the field portion of the course.

Additional challenges that occurred due to the shorter timeframe in the field included (i) unfamiliarity with measuring fold axes and using a Brunton compass in general; (ii) unfamiliarity with actually measuring a stratigraphic section in the field; (iii) difficulty in providing feedback via the virtual platform or scanned images to students as they worked on their maps and cross sections (i.e., advised not to provide close face-to-face feedback on projects); and (iv) having to schedule "office hours" rather than students having full access to instructors during office days as in a normal BHNSFS camp. These limitations and drawbacks to the online and hybrid approach need to be addressed by the field geoscience education community.

OUTLOOK FOR GEOSCIENCE FIELD-BASED EDUCATION DURING COVID-19 TIMES

Like with science in general, our fields are never moribund. Based on our field-camp experience this year, many of our peers have asked us to predict what will happen to field-based education over the next 5–10 years and in the immediate short term. We feel that while we are unable to make predictions, we can forecast three key scenarios: (i) an increase in hybrid-type field courses with two phases similar to our trial course, which limits the amount of time spent physically in the same location and thereby decreases the risk of an outbreak; (ii) a decrease in field courses as universities accelerate online teaching to accommodate the circumstances of the pandemic and increase global reach; and (iii) an increase in field courses due to an increase in demand from the postponement, delay, and cancellation of courses since early to mid-2020.

The first scenario may become increasingly common in the short term for the following reasons: (i) instructors now have abundant material that they can use to teach remote courses; (ii) the wear-and-tear of travel is significantly reduced for the student and instructor and requires much less logistical preparation; and (iii) this scenario can accommodate both those who learn best online and in the field, so it is more "equal" in its delivery.

The second scenario may occur due to budget cuts, a change in curriculum, or a wholesale acceptance that field camp is no longer required for an undergraduate geoscience degree. We tend to disagree with all of these reasons. For many universities adapting this type of training and course delivery, it bodes well for demand for field courses run by field stations with fairly large year-round enrollments.

Third, we believe demand for field-based courses may actually rise. Of the ~250 students enrolled to take our field camps for the summer of 2020, nearly 75% of them canceled and deferred for a later date. Accounting for the students still in their sophomore and junior years who plan to enroll in field camp during 2021–2022, this could represent a nearly 4× increase from 2020. This scenario will require advance planning to provide space for all of the students who will enroll in field camp. This rather optimistic scenario also agrees with other observations that "a field camp cannot be run online" and that there is no substitute for "in-the-field mapping" to train students on field geology methods.

CONCLUSIONS

Due to the COVID-19 pandemic, many field-based geoscience programs have been temporarily suspended. The experiences described herein provide a benchmark for planning and executing hybrid field geology courses during the COVID-19 pandemic. Our aim is to provide these observations as a way to facilitate constructive dialogue among the geoscience education community, including students and faculty and stakeholders alike, to continually hone, refine, and innovate the way we educate our next generation of earth scientists, many of whom will discover important energy resources for our world. We hope this contribution will serve as a useful guide for universities and businesses planning to hold face-to-face activities during this time of uncertainty.

ACKNOWLEDGMENTS

This study could not have been possible without the support and data provided by the South Dakota School of Mines and Technology and the Black Hills Natural Sciences Field Station. In particular, we thank the late Dr. Alvis Lisenbee for his generosity of spirit in teaching us how to map the challenging terrain of the Black Hills. Dr. Lisenbee spread joy for the geosciences and his enthusiasm for the thrill of discovery in field mapping is a key mindset instilled in all of us. We also thank all of the students and vendors (too numerous to name) involved in creating successful field camps throughout the years. Thank you to D. Chiarella and an anonymous reviewer for their thorough and comprehensive reviews of the manuscript that greatly improved its readability and impact. JR also thanks the brilliant and talented Dr. Pooja Sodha for her inspiration to this contribution.

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Manuscript received 4 Sept. 2020
Revised manuscript received 13 Nov. 2020
Manuscript accepted 2 Dec. 2020

THE GEOLOGICAL SOCIETY OF AMERICA®

2021 GSA Section Meetings

Northeastern

14–16 March
Online Meeting
https://www.geosociety.org/ne-mtg

The skyline of Hartford, Connecticut, as seen from across the Connecticut River. Image by Jimaro Morales from Pixabay.

Southeastern

1–2 April
Online Meeting
https://www.geosociety.org/se-mtg

William J. Samford Hall, Auburn University. The George F. Landegger Collection of Alabama Photographs in Carol M. Highsmith's America, Library of Congress, Prints and Photographs Division.

Joint North-Central/South-Central

18–20 April
Online Meeting
https://www.geosociety.org/nc-mtg

Downtown Springfield Park Central Square. Photo courtesy of the Springfield, Missouri, Convention and Visitors Bureau.

Cordilleran

12–14 May
Online Meeting
https://www.geosociety.org/cd-mtg

Volcanic geology of the Virginia Mountains, Nevada. Photo courtesy of Dr. Philipp Ruprecht, UNR faculty member.

Rocky Mountain

Meeting Postponed
until 2023

Pineridge Natural Area. Image by Jan Alexander from Pixabay.

FINAL ANNOUNCEMENT

Cordilleran Section

117th Annual Meeting of the Cordilleran Section, GSA

12–14 May 2021

www.geosociety.org/cd-mtg

Volcanic geology of the Virginia Mountains, Nevada, USA. Photo courtesy of Dr. Philipp Ruprecht.

LOCATION

The 2021 GSA Cordilleran Section Meeting will be online to ensure everyone's safety and health and to allow as many people as possible to attend. The program includes a diverse range of technical sessions and field trips, and we hope you can join us for an exciting online meeting in May!

REGISTRATION

Early registration deadline: 5 Apr.
Cancellation deadline: 12 Apr.

For further information or if you need special accommodations, please contact the meeting general chair, Stacia Gordon, staciag@unr.edu.

REGISTRATION FEES (all fees are in U.S. dollars)

	Early	Standard
Professional Member	$100	$125
Professional Member 70+	$75	$100
Professional Nonmember	$125	$150
Early Career Professional Member	$75	$100
Student Member	$25	$40
Student Nonmember	$35	$50
K–12 Professional	$40	$65

TECHNICAL SESSIONS

You must be registered for the meeting in order to attend the technical sessions. Technical sessions are scheduled for 12–14 May. For additional information, contact the technical session co-chairs: Wendy Calvin, wcalvin@unr.edu; Kait Keegan, kkeegan@unr.edu; Philipp Ruprecht, pruprecht@unr.edu; or Matthieu Harlaux, mharlaux@unr.edu.

ONLINE FIELD TRIPS

There is no fee for these field trips; the price is included in registration cost. For additional information, please contact the field-trip co-chairs: Basil Tikoff, basil@geology.wisc.edu; David Greene, greened@denison.edu; Andy Barth, ibsz100@iupui.edu; or Jim Faulds, jfaulds@unr.edu.

Cretaceous Arc Granites and Dextral Shear Zones of Northwestern Nevada. Sat., 15 May. Sarah Trevino, University of Wisconsin–Madison, sfshields@wisc.edu; Nick van Buer, California State Polytechnic Pomona, vanbuer@gmail.com; Basil Tikoff, University of Wisconsin–Madison, basil@geology.wisc.edu; Sandra Wyld, MapTect, swyld2@gmail.com.

The Blast, the Quake, and the Bomb: An Accessible, Virtual Tour of High-Energy Events in Western Nevada. Mon., 10 May. John Louie, University of Nevada–Reno, louie@unr.edu.

Geologic, Geophysical, and Tectonic Field Trip across the Central Sierra Nevada along Highways 140 and 120. Tues., 11 May. Warren J. Nokleberg, U.S. Geological Survey, wnokleberg@usgs.gov; Russell W. Graymer, U.S. Geological Survey, rgraymer@usgs.gov; Victoria E. Langenheim, U.S. Geological Survey, zulanger@usgs.gov; Matt O'Neal, matt.oneal@conservation.ca.gov.

Hypogenic Karst of the Great Basin. Mon., 10 May. Louise D. Hose, University of Nevada–Reno, hose@drkarst.net; Gretchen Baker, National Park Service, Great Basin National Park, Gretchen_Baker@nps.gov.

Virtual Roadside Geology of Northern Colorado. Sat., 15 May. Barbara EchoHawk, Metropolitan State University of Denver, echohwk@msudenver.edu; Uwe R. Kackstaetter, Metropolitan State University of Denver, kackstae@msudenver.edu.

From Mantle to Mountain Top—Palinspastic Restoration of the Interstate 70 Transect, Colorado, USA. Sun., 16 May. Ned Sterne, independent geologist, nedsterne@aol.com; Bob Raynolds, Denver Museum of Nature & Science, bobraynolds1@gmail.com; Jim Granath, consulting structural geologist, jwgranath@q.com.

SHORT COURSE

There is no fee for this short course; the price is included in registration cost. For additional information, please contact the short course chair: Rich Koehler, rkoehler@unr.edu.

Assessing Contaminant Sources/Release Ages and Aquifer Continuity in Soil/Groundwater Systems Using Stable Radiogenic Isotopes of Strontium (Sr) and Lead (Pb). Tues., 11 May. Richard W. Hurst, California Lutheran University, rhurst@callutheran.edu.

VIRTUAL PALEONTOLOGICAL SOCIETY MEET-UP/NETWORKING EVENT

Please stop by to meet or reunite with other paleontologists. Students and anyone curious about paleontology are very much encouraged to attend!

OPPORTUNITIES FOR STUDENTS AND EARLY CAREER PROFESSIONALS

Career Workshop

This workshop will feature career development planning, an exploration of geoscience job sectors, and information on best practices for crafting a résumé and cover letter. Non-technical skills and workforce statistics will be reviewed. No registration is required, and everyone is welcome.

Career Mentoring Programs

GSA student members—ask your career-related questions and learn about non-academic pathways in the geosciences while networking with professionals at the Roy J. Shlemon and John Mann Mentor Programs.

Learn more at **https://www.geosociety.org/mentors.** Questions? Contact Jennifer Nocerino at jnocerino@geosociety.org.

ORGANIZING COMMITTEE

Meeting General Chair: Stacia Gordon, staciag@unr.edu
Technical Session Co-Chairs: Wendy Calvin, wcalvin@unr.edu; Kait Keegan, kkeegan@unr.edu; Philipp Ruprecht, pruprecht@unr.edu; Matthieu Harlaux, mharlaux@unr.edu
Field Trip Co-Chairs: Basil Tikoff, basil@geology.wisc.edu; David Greene, greened@denison.edu; Andy Barth, ibsz100@iupui.edu; Jim Faulds, jfaulds@unr.edu
Short Course Chair: Rich Koehler, rkoehler@unr.edu
Student Volunteer Co-Chairs: Wenrong Cao, wenrongc@unr.edu; Mike Darin, mdarin@unr.edu

GeoCareers Programs at the 2021 Section Meetings

MENTOR PROGRAMS

GSA student members will have the opportunity to discuss career prospects and challenges with applied geoscientists from various sectors.

Northeastern: Online Meeting
Shlemon Mentor Program: Sunday, 14 Mar.
Mann Mentors in Applied Hydrology Program: Monday, 15 Mar.

Southeastern Section: Online Meeting
Shlemon Mentor Program: Thursday, 1 Apr.
Mann Mentors in Applied Hydrology Program: Friday, 2 Apr.

Joint North-Central South-Central Section: Online Meeting
Shlemon Mentor Program: Sunday, 18 Apr.
Mann Mentors in Applied Hydrology Program: Monday, 19 Apr.

Cordilleran Section: Online Meeting
Shlemon Mentor Program: Wednesday, 12 May
Mann Mentors in Applied Hydrology Program: Thursday, 13 May

CAREER WORKSHOP

This workshop will be offered at each of the 2021 Section Meetings and will feature career planning, an exploration of geoscience job sectors, tips on how to get your résumé noticed, and what employers are looking for in new hires. You'll also learn about best practices for crafting a résumé and cover letter. Nontechnical skills and Individual Development Plans (IDPs) will be reviewed. No registration is required, and everyone is welcome.

The Geological Society of America®
GEOCAREERS

Get into The Field with These GSA Awards

J. David Lowell Field Camp Scholarships

The importance of field schools to practicing geologists is unquestionable, yet the opportunities to experience field geology are dwindling. GSA and the GSA Foundation are proud to announce that the J. David Lowell Field Camp Scholarships will be available to undergraduate geology students for the summer of 2021. These scholarships provide awardees with US$2,000 to attend the field camp of their choice. Applications are reviewed based on diversity, economic/financial need, and merit. Students must submit an online application form, two letters of recommendation, and a cover letter.

Who should apply? Undergraduate students

Deadline: 19 March

GSA-ExxonMobil Field Camp Excellence Award

GSA also offers support to field camp instructors and directors for field camp improvements and/or operations. This US$10,000 award will be based on safety awareness, diversity, and technical excellence and can be used to assist with the awardee's summer field season.

Who should apply? Field camp instructors and directors. The award must be used toward field camp operations and/or improvements.

Deadline: 19 March

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GSA FOUNDATION

Learn more at **https://www.geosociety.org/field-experiences.** Questions? Contact Jennifer Nocerino, jnocerino@geosociety.org.

THE GEOLOGICAL SOCIETY OF AMERICA®

CONNECTS 2021

10–13 October
Portland, Oregon, USA

"GSA CONNECTS": WHAT DOES THAT MEAN?

Connection captures the heart of our meeting activity no matter where we gather. GSA connects you to geoscience. The meeting connects you to each other and to the tools you need to advance in your professional life. In 2021, we'd love to welcome you to the new spirit of GSA Connects. Present your cutting-edge research, attend innovative sessions, and grow your network like never before. Submit your abstract by 20 July and discover what real connection means.

IMPORTANT DATES

Mid-May: Space-request system opens (non-technical, social, and business meeting room requests)

Early June: Registration and travel grant applications open

Mid-June: Housing opens

28 June: Space-request system deadline—fees increase after this date

20 July: Abstracts deadline

August: Student volunteer program opens

7 September: Early registration deadline

7 September: GSA Sections travel grants deadline

13 September: Registration and student volunteer cancellation deadline

15 September: Housing deadline for discounted hotel rates

NON-TECH SPACE-REQUEST SYSTEM

We have adjusted the timeline around the space-request system for non-tech and social events. We are waiting until mid- to late May to open the system in the hopes we will have more information regarding guidelines around in-person events. We will continue to plan the non-tech events to adapt to changing circumstances. If you have any questions, please contact spacerequest@geosociety.org.

HOTEL INFORMATION

The GSA housing bureau will open hotel reservations in June. The Hyatt Regency Portland at the Oregon Convention Center will serve as GSA headquarters and the DoubleTree by Hilton Portland is the co-headquarters hotel. Both hotels are located within walking distance of the Oregon Convention Center (OCC). The GSA block includes six hotels offering rates from US$189 to US$254 single occupancy (per night, plus tax). Three hotels are in the OCC area, and three hotels are in the city center.

Protect yourself: As the number of online hotel bookings continues to increase, so does the rate of booking scams. Only use a trusted source to make your hotel reservation and beware of anyone contacting you directly via email, phone, or fax. If you have any questions, please contact the GSA meetings department at meetings@geosociety.org. We will post information to our website regarding hotel reservations in June.

GSA 2020 Annual Ethics Report

Over the past several years, GSA has implemented several strategies to foster ethical, respectful, and inclusive conduct by our members and editors in carrying out their professional activities and by those who participate in GSA-sponsored events. Through our ethics program, GSA sets clear conduct standards to guide our leaders, members, and program participants to act with integrity, professionalism, and respect in all of their professional activities. These policies make it clear that GSA takes alleged violations seriously and will use a fair process to hold individuals accountable for engaging in dishonest, unethical, and exclusionary behaviors—including bullying and all forms of discrimination and harassment—that undermine full participation and excellence in the earth-science profession.

We are pleased to announce the publication of our 2020 Annual Ethics Report, which includes detailed information on the ethics program goals and progress. Go to **https://www.geosociety.org/ethics** to read the report.

The Expanding Representation in the Geosciences Scholarship Offers More Than Just a Financial Award to Students

Tahlia Bear, *GSA Diversity and Career Officer*

Over the past decade, GSA has operated a scholarship program for undergraduate students who come from communities underrepresented in the geosciences. While the name has evolved, its intention has never changed in its aim to help defray the cost of education for students pursuing a degree in the geosciences.

The Expanding Representation in the Geosciences (ERG) Scholarship, established in 2011, awards up to six students per year from each GSA regional Section a scholarship of US$1,500. In addition to the award, students receive a complimentary one-year GSA membership, full meeting registration for the upcoming annual meeting, where a student reception is held, an invitation to On To the Future events, and mentorship at the annual meeting. Since its inception, 57 students have been awarded, with over 75% of awards going to Black, Indigenous, and People of Color.

Last year, six students from across the United States received awards:

- GSA Cordilleran Section: **Alexa Terrazas,** University of California Los Angeles
- GSA North-Central Section: **McKenna Riggen,** The University of Texas at Austin
- GSA Northeastern Section: **Kierra Wilk,** Rensselaer Polytechnic Institute
- GSA Rocky Mountain Section: **Alice Morris,** Fort Lewis College
- GSA South-Central Section: **Brittany Bray,** South Dakota School of Mines and Technology
- GSA Southeastern Section: **Amanda Mayo,** The University of Tennessee at Martin

"This opportunity reaffirmed that I am pursuing the right field. As my education progressed, I became more and more passionate about studying geology, in particular planetary geology, but there was always a part of me that wondered if I was 'good enough' or making the 'right' decision. Being able to attend the online GSA conference, present my work, discuss and understand current research in the field, and just generally being recognized for the work and effort I have devoted over the past four years was definitely a series of 'feel good' moments." —Kierra Wilk

"This opportunity and experience helped curate my interests and fortified my desire to become a geoscientist. I aspire to share my research with the geoscience community and inspire others in the future." —Alexa Terrazas

GSA is accepting applications for the ERG scholarships beginning 1 March through 15 May. Questions about this opportunity can be directed to awards@geosociety.org.

https://www.geosociety.org/erg

Expand Your Professional and Peer Network by Applying to the On To the Future Program

Applications are now being accepted for GSA's popular On To the Future (OTF) program. If you are a student or recent graduate from a group underrepresented in the geosciences who has never attended an annual GSA meeting, apply by 28 May. Awardees will receive a travel grant to attend the GSA Connects 2021 meeting in Portland, Oregon, USA. Included with your award is a one-year GSA membership, full meeting registration, mentorship at the meeting, special morning sessions with leadership, a reception, and professional and peer connections that will last you a lifetime.

GSA encourages low-income, Black, Indigenous, and People of Color, first-generation, non-traditional, women, veterans, LGBTQ+, and students with disabilities to apply.

www.geosociety.org/OTF

Mentor the Next Generation of Scientists

Join Mentoring365, a virtual three-month mentoring program to connect with students and early career scientists, share career experiences, and give back to the geoscience community. Mentoring365 is a partnership among earth- and space-science organizations and was developed to facilitate dialogue and collaborative learning between mentoring pairs.

https://mentoring365.chronus.com/p/p1/

Subscribe or Contribute to GeoScene

Stay current on the latest resources and opportunities by subscribing to GSA's monthly email newsletter designed for geoscience students and early career professionals. Each newsletter features job opportunities, upcoming webinars, career advice, and more.

Do you have an idea for an article that would benefit fellow readers? Email education@geosociety.org to pitch your idea.

www.geosociety.org/geoscene

GSA Science Policy Fellow: An Amazing Student Opportunity to Work on Geoscience Legislation

Connor Dacey

If you would have told me a year ago that I would be working as the 2020–2021 Geological Society of America (GSA) Science Policy Fellow, I probably wouldn't have believed you—not because I did not have an interest in policy, but because I figured I would be jumping directly into a career in operational emergency management after wrapping up my dissertation and finishing my Ph.D. in disaster science and management from the University of Delaware. However, now having been a fellow for a few months, I can honestly and enthusiastically say that I am profoundly grateful for the opportunity to represent GSA.

I was drawn to the GSA Science Policy Fellowship for numerous reasons. First, I have always had an interest in policy despite being formally trained as a physical and social scientist. My background is in meteorology, having obtained B.S. and M.S. degrees in meteorology and atmospheric and oceanic sciences from Florida State University and the University of Wisconsin–Madison, respectively. I completed numerous internships and work experiences throughout my educational journey as I tried to learn what I wanted to do for a career. For example, I interned at The Weather Channel, volunteered with the National Weather Service, and even interned with the 45th Weather Squadron at the U.S. Air Force. Though I thoroughly enjoyed each of these experiences, I wanted to continue to grow and learn in other fields. While working on my Ph.D., I completed an internship in emergency management with the Madison Fire Department in Madison, Wisconsin, USA, and believed I found my career path.

Nevertheless, I still had a nagging curiosity about policy, being especially concerned about environmental policy. Yearning to learn more, I took several environmental and energy policy classes while in graduate school, being most interested in topics such as climate change, disaster preparedness, and renewable energy. I wanted to learn more about how science applied to actual policy work and implementation. The GSA Science Policy Fellowship presented itself as an opportunity to work at this intersection and learn the legislative process by tracking geoscience-related legislation as it passes through Congress and assisting in the development of strategic communication to policy makers.

Second, I have always been interested in bridging the gap between scientists and policy makers. I strongly believe that one of the primary responsibilities of scientists is to convey scientifically backed information to those in political power when given the opportunity, in the hopes of spurring meaningful legislation. This fellowship has allowed me to do just that.

Finally, the fellowship seemed like a great opportunity to network. As a Fellow, I have been able to network with professionals across scientific agencies and organizations, which has been especially rewarding and important to me as a recent graduate and working my first job outside of academia.

Due to COVID-19, my experiences as the GSA Science Policy Fellow are much different than those fellows that came before me. Nevertheless, I have been able to fulfill many of the same roles and responsibilities. My weeks consist of attending virtual meetings as a member of working groups like geopolicy and climate science. I helped assist with the first virtual Geoscience Congressional Visits Day and attended the GSA 2020 Connects Online meeting. I attend webinars and take notes on topics relating to geoscience legislation. I also contribute to the GSA "Speaking of Geoscience" blog and help to keep GSA members updated on the latest legislation. Overall, it has been a fulfilling experience as the GSA Science Policy Fellow.

I would strongly advise those students who are graduating soon and have an interest in science policy to consider applying for the 2021–2022 GSA Science Policy Fellowship, even if you are not sure whether you want to pursue a career in science policy. GSA is filled with wonderful and knowledgeable individuals who have shown me incredible kindness, support, and patience during these trying times.

The application deadline for the GSA Science Policy Fellow is 15 May. Additional details on the fellowship and application process are available on GSA's website (**https://www.geosociety.org/GSA/Science_Policy/GSA_Science_Policy_Fellowship/GSA/Policy/policyFellow.aspx**). GSA also offers a Congressional Science Fellowship (**www.geosociety.org/csf**). This fellowship, jointly sponsored by the U.S. Geological Survey, differs from the Science Policy Fellowship in that it allows one to work directly with a member of Congress or congressional committee, and has an annual application deadline of 15 Jan.

Please feel free to reach out to me at any time at sciencepolicy@geosociety.org, and I'd be happy to try to answer any questions or further discuss these opportunities.

POLICY UPDATE

Geoscience Bills Become Law

Connor Dacey, *GSA Science Policy Fellow, and* ***Kasey White,*** *GSA Director for Geoscience Policy*

From a pandemic to the presidential election, 2020 was a year of unforgettable moments and events. While the nation focused on COVID-19 and the elections, the 116th Congress passed multiple pieces of geoscience-related legislation in its waning days. Bills addressing landslides, space weather, marine plastics, and coastal changes became law. Many of these bills expand geoscience programs and initiatives that transcend the public, private, and academic sectors. In doing so, these new laws align with recommendations in many of GSA's position statements, including, for example, the need for increased investment in geoscience research and data collection.

GSA members played a critical role in passing these bills. Several bills saw progression throughout the legislative process after geoscientists discussed them during Geoscience Congressional Visit Days. Examples include the following:

1. The Promoting Research and Observations of Space Weather to Improve the Forecasting of Tomorrow (PROSWIFT) Act (S. 881) was signed into law on 21 Oct. 2020. This bill lays the foundation for how different federal agencies will work together to better forecast, research, and mitigate the effects of space weather. The bill also directs federal agencies to prioritize space-weather research and develop a reliable backup option for solar wind and coronal mass-ejection imagery, and establishes an interagency working group and pilot program for work with the private sector. A space-weather advisory group with members from the academic, commercial, and nongovernmental space weather end-user community will be established to "identify the space weather research, observations, forecasting, prediction, and modeling advances required to improve space weather products."
2. The Save our Seas 2.0 Act (S. 1982) became law on 18 Dec. 2020. The bill follows the Save our Seas Act, which authorized the National Oceanic and Atmospheric Administration's (NOAA) Marine Debris Program in 2018. Among its provisions to reduce marine plastics, this successor bill establishes a Marine Debris Response Trust Fund for NOAA to use in responding to marine debris events, creates a Marine Debris Foundation, authorizes a prize competition, and encourages international collaboration.
3. Signed into law on 18 Dec. 2020, the Digital Coast Act (S. 1069) directs NOAA to create a "one-stop-shop" for geospatial data and information, tools, and resources to aid scientists and decision makers in flood and coastal storm surge prediction, hazard risk and vulnerability assessments, emergency response and recovery planning, and community resilience to long-range coastal changes. The bill authorizes US$4 million for each fiscal year 2021 through 2025 to develop "an enabling platform that integrates geospatial data, decision-support tools, training, and best practices to address coastal management issues and needs."
4. The Coordinated Ocean Observations and Research Act (S. 914) became law on 31 Dec. 2020. The bill reauthorizes the Integrated Coastal and Ocean Observation System, which is a network of federal and regional entities that provide data, tools, and forecasts about the nation's coasts, oceans, and Great Lakes. The law also formally authorizes the existing National Water Center at NOAA.
5. The National Landslide Preparedness Act (H.R. 8810), which became law on 5 Jan. 2021, establishes a National Landslide Hazards Reduction Program at the U.S. Geological Survey (USGS) to better identify and understand landslide risks, protect communities, save lives and property, and improve emergency preparedness. Activities as part of this program include identifying, mapping, assessing, and researching landslide hazards; responding to landslide events; establishing working groups with state offices; and developing landslide guidelines for geoscientists, emergency management personnel, and land-use decision makers. The bill also codifies the U.S. Geological Survey 3D Elevation Program to update and coordinate the collection of elevation data across the country using enhanced, high-resolution surveys.

Overall, several geoscience-friendly bills successfully passed through Congress and were eventually signed into law. Each of these five bills align with many of GSA priorities and position statements and are proof that meaningful legislation can be passed with the additional push from GSA members and other geoscientists. GSA looks forward to continuing to support and progress additional geoscience legislation throughout the term of the 117th Congress.

CALL FOR GSA COMMITTEE SERVICE

Help Shape the Future of Geoscience

Please consider nominating a member or self-nominating at **https://rock.geosociety.org/Nominations/CS.aspx.**
Deadline: 15 June 2021 | **Terms begin 1 July 2022** (unless otherwise indicated)

COMMITTEE NAME	NO. OF VACANCIES	POSITION TITLE & SPECIAL REQUIREMENTS	TERM (YEARS)
Academic and Applied Geoscience Relations Committee	1	Member-at-Large, Student	3
Annual Program Committee	2	Members-at-Large	4
Arthur L. Day Medal Award Committee	2	Members-at-Large	3
Bascom Mapping Award Committee	1	Member-at-Large, Student	3
Council Officers	5	President-Elect	3
		Treasurer	1
		Councilors	4
Diversity in the Geosciences Committee	3	Members-at-Large	3
Education Committee	3	Graduate Educator Representative	4
		Informal Science Educator Representative	4
		Undergraduate Student Representative	2
Geology and Public Policy Committee	2	Members-at-Large	3
GSA International Committee	5	Member-at-Large	4
		International Associated Society member	4
		Member-at-Large, North America	4
		Member-at-Large, outside North America	4
		Member-at-Large, Student	2
Membership and Fellowship Committee	3	Members-at-Large, Academia (2)	3
		Member-at-Large, Government	3
Nominations Committee	2	Member-at-Large	3
		Member-at-Large, Government	3
North American Commission on Stratigraphic Nomenclature	1	GSA Representative	3
Penrose Conferences and Thompson Field Forums Committee	4	Members-at-Large	3
Penrose Medal Award Committee	2	Members-at-Large	3
Professional Development Committee	2	Former Councilor	3
		Member-at-Large, Student	3
Publications Committee	2	Member-at-Large	4
		Member-at-Large, Early Career Professional	4
Research Grants Committee	11	Members-at-Large (various specialties)	3
Young Scientist Award (Donath Medal) Committee	2	Members-at-Large	3

GSA Elections

We congratulate our incoming president who was elected by GSA membership in 2020.

Barbara (Barb) L. Dutrow

PRESIDENT
(July 2021–June 2022)

Barbara (Barb) L. Dutrow
Louisiana State University
Baton Rouge, Louisiana, USA

2021 OFFICER AND COUNCIL CANDIDATES

GSA Elections Begin 10 March 2021.

GSA's success depends on you—our members—and the work of the Officers and Councilors serving on GSA's Executive Committee and Council.

Notice of the election will be posted on the GSA website with instructions for accessing the online ballot via our secure website. Members may expect an electronic voting reminder. When the ballot opens, information on the candidates will be available online for review. Paper versions of the ballot and candidate information will be available upon request.

Please help continue to shape GSA's future by voting on these candidates.

Ballots must be submitted electronically or postmarked by 9 April 2021.

VICE PRESIDENT/ PRESIDENT-ELECT
(July 2021–June 2023)

Mark Gabriel Little
University of North Carolina at Chapel Hill
Chapel Hill, North Carolina, USA

TREASURER
(July 2021–June 2022 [continuing])

Richard C. Berg
Illinois State Geological Survey
Champaign, Illinois, USA

COUNCILOR POSITION 1
(July 2021–June 2025)

J. Wright Horton Jr.
U.S. Geological Survey
Reston, Virginia, USA

Gene Peters
FBI Laboratory
Springfield, Virginia, USA

COUNCILOR POSITION 2
(July 2021–June 2025)

Jean Hsieh
Sedimentary Geology Consultants
Calgary, Alberta, Canada

Pinar O. Yılmaz
Retired (ExxonMobil Upstream Integrated Solutions Co.)
Houston, Texas, USA, and Izmir, Turkey

COUNCILOR POSITION 3
(July 2021–June 2025)

Stephen Boss
University of Arkansas
Fayetteville, Arkansas, USA

Donna Jurdy
Northwestern University
Evanston, Illinois, USA

POSITIONS OPEN

Tenure Track Faculty Hire in Applied Geophysics, Department of Geological Sciences, University of Alaska Anchorage

The Department of Geological Sciences in the College of Arts and Sciences at the University of Alaska Anchorage (UAA) seeks applications from exceptional candidates for a tenure track faculty position in the broad area of Applied Geophysics with a start date of August 2021. The position will complement existing fields of expertise in environmental geochemistry, hydrology, paleoclimate, petrology, volcanology, structure, stratigraphy, and planetary geoscience in support of the B.S. and M.S. degree programs in the department. Although all areas of Applied Geophysics will be considered, expertise that can contribute to both environmental and resource geology applications is preferred.

We seek applicants with a commitment to teaching, research, and partnership building with resource industries and research organizations in Alaska and elsewhere. Applicants must hold a Ph.D. in geological sciences or a closely related discipline and should demonstrate university level teaching experience. Industry or postdoctoral experience will be considered favorably. Teaching expectations for this position will be variable each year but may include introductory geology courses, applied geophysics, geologic data analysis, and specialized undergraduate and graduate courses in the fields of applied petroleum geoscience and environmental geophysics or other courses in support of the department's teaching needs.

Successful candidates must develop an externally funded research program that actively involves graduate and undergraduate students. The successful candidate would also benefit from access to the department's state-of-the-art computational laboratory with 20 high-end workstations and over $100M of donated commercial software for teaching and research purposes.

Interested applicants should submit a statement of interest that outlines their qualifications for this position and includes a research plan, teaching interests, curriculum vitae, and the names and contact information of at least three references. Applications must be submitted to Job #516290 at www.alaska.edu/jobs/. Review of applications will begin February 22, 2020 and will continue until the position is filled. For more information about this position, please contact the search chair, Eric Klein, at esklein@alaska.edu. All applicants must be eligible for employment under the immigration Reform and Control Act of 1986 and subsequent amendments. Your application for employment with UAA is subject to public disclosure under the Alaska Public Records Act.

UAA is an AA/EO Employer and Educational Institution. At UAA, valuing diversity is integral to excellence. Diversity maximizes our potential for creativity, innovation, educational excellence, and outstanding service to our communities. The University fosters an inclusive, welcoming and respectful campus community that promotes diversity, civility, equity, inclusion, and an appreciation for each unique member of our academic community. UAA promotes and celebrates diversity through its academic and community support programs, committees, and councils. We honor diverse experiences and perspectives and strive to create welcoming and inclusive learning environments where all are treated with respect. UAA strives to support its unique and diverse community by employing faculty who come from a myriad of different backgrounds.

Post-Doctoral Research Associate, Northwestern University

A two-year post-doctoral research associate position is available in the Department of Earth and Planetary Sciences at Northwestern University to investigate deep-time ocean acidification (OA) events using multiple stable and radiogenic isotope systems, including B, C, Ca, S, and Sr. The position is funded by the Ubben Program for Climate and Carbon Science administered by the Institute of Sustainability and Energy at Northwestern (ISEN). Applications are encouraged from candidates with experience in general and clean room chemistry, gas source and thermal ionization mass spectrometry, biomineralization, carbonate geochemistry, sedimentology, and numerical modeling. In addition, the successful candidate should have strong communication skills as they will work with colleagues in the Medill School of Journalism to publish a popular science article in a leading outlet highlighting paleo-OA research findings in relation to current and potential future OA.

Review of applications will begin on April 1, 2021. The start-date can be flexible, but no later than September 2021 (assuming easing of pandemic restrictions). Candidates must have a PhD by the start date. Salary is commensurate with qualifications and experience. Applicants should submit a cover letter, statement of research interests and experience, CV, and list of three references, including e-mail addresses and phone numbers, with the subject line "OA Postdoc" to earth@northwestern.edu; electronic submission of a single pdf file is preferred; or Department of Earth and Planetary Sciences, Northwestern University, 2145 Sheridan Rd., Evanston, IL 60208. Questions about the position can be addressed to Andrew Jacobson (adj@earth.northwestern.edu), Matt Hurtgen (matt@earth.northwestern.edu), or Brad Sageman (brad@earth.northwestern.edu).

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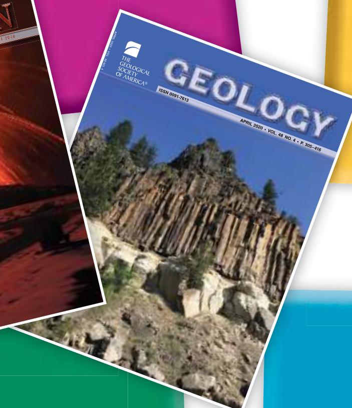

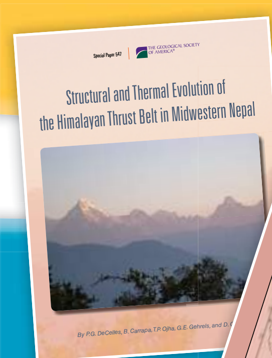

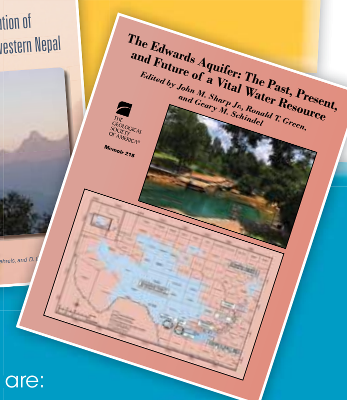

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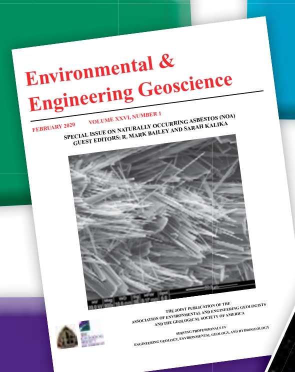

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Bringing the Field to Students during COVID-19 and Beyond

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BACKGROUND

Undergraduate field-based experiences are valued components of geoscience education (Hendrix, 1967; Petcovic et al., 2014). However, the belief that it is "impossible to simulate [field] situations … to make … structural, stratigraphic, geomorphologic, lithologic, etc. observations in solving a single problem" (p. 161, Hendrix and Suttner, 1978) means widespread efforts to make field experiences more accessible to students are missing, which results in a culture of exclusion. The COVID-19 pandemic is forcing educators to re-think how to design field courses. This article describes first-hand experiences tackling the "impossible" to support students graduating on time and provide an instructional design model for post-pandemic field education that is more physically accessible than traditional models of field instruction.

INSTRUCTIONAL DESIGN GOALS

Scheduled to teach the "Introduction to Field Geology" course for the first time during the COVID-19 pandemic, I was given the choice to cancel or teach remotely. I chose the latter. My first instructional design goal for this remote version of the course was for it to, as much as possible, be the same as the in-person version I would teach in the future. From this first design goal emerged three others. Students should be able to remotely (1) explore the field environment independently and not be strictly prescribed where to stop, what to look at, and what questions to ask and answer; (2) work with digital renditions of real geologic environments, not animated or contrived environments; and (3) visit local field sites. In short, my motivating design goal was to bring the field to the students because I could not bring them to the field.

INSTRUCTIONAL DESIGN METHODS

The primary focus of this article is the technologies used to bring local field sites to my students. Students were reminded that this field course was being taught remotely due to the university's COVID-19 policy for summer courses. We also discussed the fact that geologic fieldwork is often conducted remotely today using a variety of visual data. Thus, they would have opportunities to develop essential skills applicable to both on-the-ground fieldwork and remote fieldwork.

Three cameras captured visual data to bring the field to the students for all field assignments in this course: standard GoPro camera, Insta360 Pro camera, and digital SLR camera. The GoPro captured continuous wide-angle videos along each traverse, which students viewed first to do a general reconnaissance. The Insta360 Pro camera captured high-resolution 360° panoramic digital images (referred to as "panos" hereafter), which students viewed second using free PTGui software that converted panos into 3D virtual-reality settings in which students could turn around and look up and down in any direction, zoom in and out of any field of view they chose, and independently explore the environment. The panos were taken at locations along each traverse where rock exposures were least obscured by vegetation. Each field assignment had six to seven pano sites, but only three were plotted on the provided contour map with each assignment. The plotted locations served as anchor sites for orientation purposes. To practice self-location, students plotted the remaining pano sites. North-pointing plastic markers were laid around the base of the Insta360 Pro camera during the capture of each pano, and students were instructed to use them as substitutes for using a compass in the field to find north.

Additionally, panos had yellow plastic number tents at random locations so students could use these markers as common points of reference while talking with each other and me about their field observations (Fig. 1). A 100-m measuring tape was laid along many traverses, and a photo was first taken of the measuring tape and then of a yellow plastic number tent to aid students in developing a sense of distance and scale. After watching the GoPro videos and exploring the 3D virtual reality panos, students then viewed standard high-resolution 2D photos taken with the SLR camera. These photos contained yellow number tents with printed ruler gradations at their base and rulers or other objects for scale to aid students in making and describing observations. Field assignments were posted in Canvas for students to download. Students accessed all visual data from a Google Drive folder and downloaded the 360° panos to their personal computers to view with the PTGui software. Students used the CamScanner phone app to scan their completed field notes for each assignment and uploaded them to Canvas for instructor review and grading.

LEARNING GOALS

In designing this course with the intentions to (1) immediately teach it remotely and (2) teach it in person in the future, I initially articulated six course-level learning goals. By the end of the course, students should be able to: (1) work independently and work collaboratively while pulling their own weight; (2) know the meaning of pertinent field geology terms and facts; (3) observe features and processes in the environment and describe observations in individual field notes and oral presentations; (4) make sense of "the field" through reasoned thinking of observations; (5) know the differences between inference, interpretation, and hypothesis as well as develop and test them as appropriate; and (6) use a Brunton compass and Jacob's staff. The sixth goal was a challenge for remote instruction. Departmental deliberations about whether to insure and mail students field equipment determined students

GSA Today, v. 31, https://doi.org/10.1130/GSATG478GW.1.

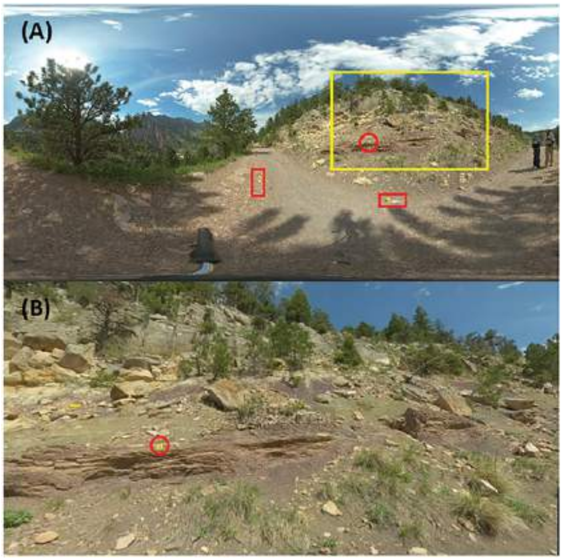

Figure 1. Insta360 Pro panorama. (A) Viewed in Microsoft Photos as a flat, 2D image. (B) Viewed in PTGui as 3D virtual reality in which one can zoom in/out, look up/down, and turn left/right. Yellow rectangle in (A) represents the field of view shown in (B). Red circles show the location of a plastic yellow number tent. Red rectangles show locations of north-pointing markers.

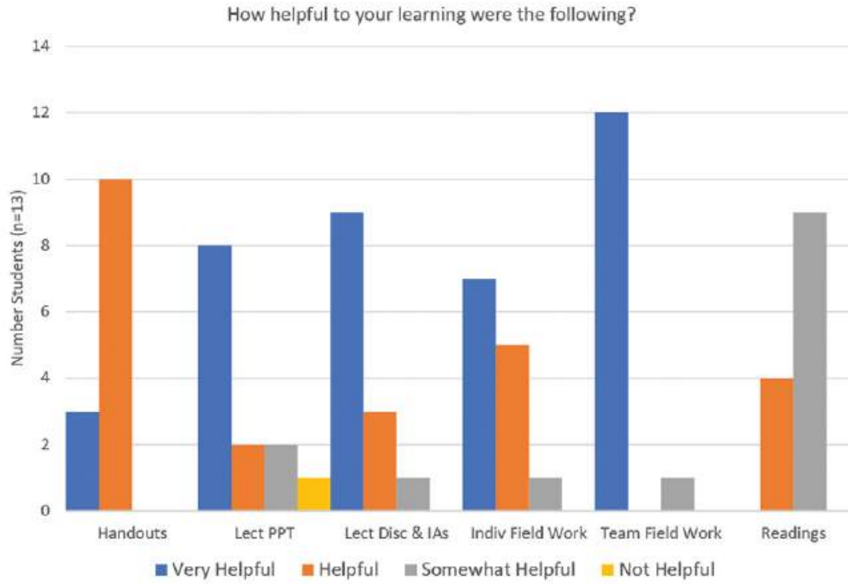

Figure 2. Responses to item on end-of-course questionnaire. IAs—in-class activities; PPT—PowerPoint.

would learn how to use the equipment in upper-division courses as needed and, meanwhile, learn how to measure strike and dip using ROCKD (a phone app).

LEARNING OUTCOMES

Field assignments were designed so that components were independently completed prior to team-based work, which took place in Zoom breakout rooms. In an end-of-course questionnaire, all but one student (12 out of 13) found the team fieldwork "very helpful" to their learning (Fig. 2). The results of a pre- and post-instruction test revealed dramatic improvement in students' knowledge of field-related geologic terms, including being able to differentiate between observations, inferences, interpretations, and hypotheses. Students' field notes and PowerPoint presentations were not only part of each field assignment, they were formative assessments that revealed overall improvement in students' ability to, for example, describe what they see and draw inferences from those observations.

LESSONS LEARNED ABOUT THE IMPOSSIBLE

Simulating the field environment was previously believed impossible; however, technological advances made it possible to bring the field to my students in a way that satisfied all my instructional design goals and helped students achieve all but one of the course-level learning goals for an in-person version of the course. Additionally, students stated that not contending with physical aspects of field work (e.g., traversing uneven ground, coping with extreme heat, etc.) helped them focus on developing cognitive and teamwork skills they will use in any field location. The model of remote field instruction developed and implemented in May 2020 is one way of supporting current students during the pandemic and of increasing the accessibility of field courses to future students across a range of physical abilities.

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Manuscript received 18 July 2020
Revised manuscript received 23 Oct. 2020
Manuscript accepted 12 Nov. 2020

Support Your Society's Greatest Needs

We have all seen and been affected by the unprecedented challenges caused by the pandemic impacting the world over the past many months. You may recall at this time last year, we launched GSA CARES (GSA COVID-19 Assistance and Relief Effort for Students) to provide immediate assistance to student members because their lives, academic studies, employment, fieldwork, research, and much more were disrupted. Thanks to you, our committed donors, and with matching amounts from both the Society and the Foundation, we were able to provide more than US$180,000 to GSA student members. In a gesture of good faith fitting for these challenging times, GSA CARES funds were simply awarded to those who experienced pandemic-related hardships affecting their education or career development, without further criteria.

Like many organizations, GSA has also been affected in this past year. Now, more than ever, our Greatest Needs Fund will be vital to sustain the very programs that define GSA and to allow the Society to respond as needed by allocating support to those areas most affected in changing circumstances. As we afforded students flexibility in how they used the support we provided, we hope that you will consider the same in giving to the Greatest Needs Fund so that the Society's leadership can make decisions and apply funds where they are needed most.

An important element of Greatest Needs is that these funds directly support programs that are essential for the furthering of geoscience—they do not go toward overhead. GSA leadership allocates the funds to increase student travel grants or research grant awards, for more On To the Future diversity awards, or to help fund the science policy fellow. Because GSA's policy work remains a vital force for our science and our future, it is a program area that could benefit significantly from the Greatest Needs Fund.

Our policy staff bring science and scientists into the policy process, keeping GSA members informed, involved, and represented in federal policy in areas such as research funding, climate-change policy, and natural hazard mitigation and response. GSA's policy office helps the community on a regular basis, such as facilitating our members' support of bills that have been recently signed into law like the Digital Coast Act. As explained by GSA's geoscience policy director Kasey White and science policy fellow Connor Dacey, this act allows the National Oceanic and Atmospheric Administration to create an easily and freely accessible online resource for geospatial data and information, tools, and resources to aid in flood and coastal storm surge prediction, hazard risk and vulnerability assessments, emergency response and recovery planning, and community resilience to longer range coastal changes. Another bill supported by our members and signed into law establishes a program to identify and understand landslide risks, protect communities, save lives and property, and improve emergency preparedness. (Further details on these and other acts can be found on page 22 of this issue.) White notes, "It speaks to the importance of geoscience and geoscientists' efforts that multiple bills to address hazards and increase the collection of ocean data were signed into law in the midst of a pandemic and economic crisis."

Make an immediate impact today! Support of the Greatest Needs Fund provides flexibility for GSA to strategically apply resources where they are most critically needed—to the programs that matter most to furthering our science and advancing the geosciences in society. If you have questions regarding the fund, or want to explore ways to significantly support GSA programs, please contact Clifton Cullen at +1-303-357-1007 or via email at ccullen@geosociety.org.

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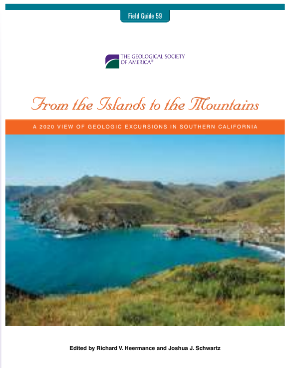

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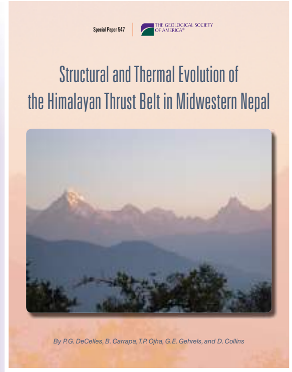

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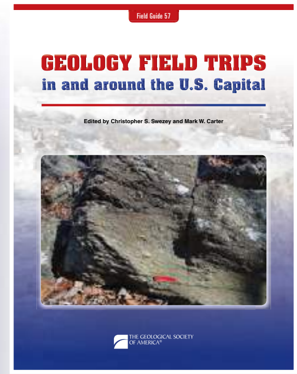

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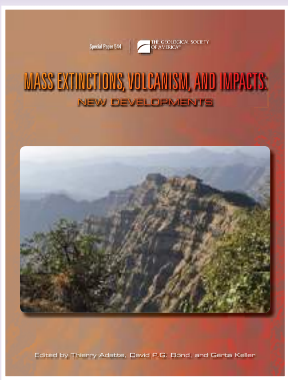

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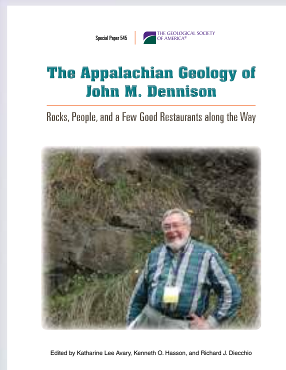

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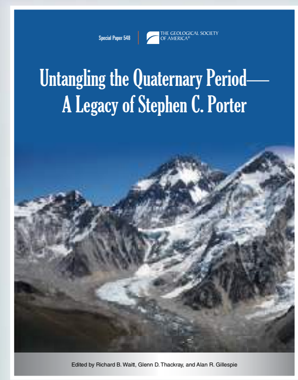

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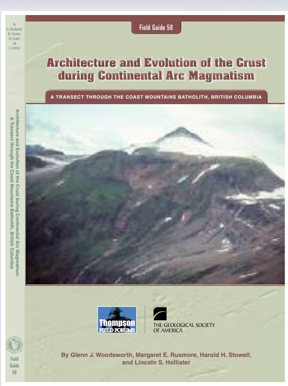

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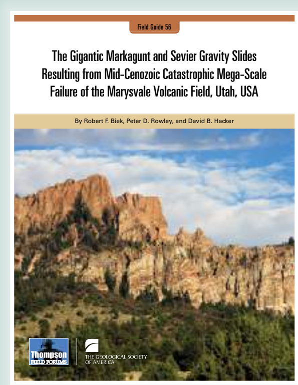

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